VOL. 28, NO. 2 FEBRUARY, 1951

AMERICAN JOURNAL OF OPTOMETRY *and* ARCHIVES *of* AMERICAN ACADEMY OF OPTOMETRY

EDITORIAL COUNCIL

HAROLD M. FISHER, Chairman, *New York, N. Y.*

IRVING M. BORISH, *Kokomo, Ind.*
V. J. ELLERBROCK, *Columbus, Ohio*
RICHARD FEINBERG, *Forest Grove, Ore.*
EUGENE FREEMAN, *Chicago, Ill.*
GLENN A. FRY, *Columbus, Ohio*
HENRY W. HOFSTETTER, *Los Angeles, Calif.*
D. G. HUMMEL, *Cleveland, Ohio*
J. DONALD KRATZ, *Souderton, Pa.*
LEO F. MADIGAN, *Boston, Mass.*
MEREDITH W. MORGAN, JR., *Berkeley, Calif.*
JOHN C. NEILL, *Philadelphia, Pa.*
HAROLD SIMMERMAN, *Woodbury, N. J.*
WILLIAM O. VIVIAN, *Media, Pa.*
GORDON L. WALLS, *Berkeley, Calif.*

STAFF

CAREL C. KOCH, *Editor*, *Minneapolis, Minn.*
ROBERT E. BANNON, *Research Editor*, *Hanover, New Hampshire*

COLLABORATORS

M. ALPERN, *Columbus, Ohio*
I. F. ANDREAE, *Baltimore, Md.*
E. BATEMAN, *Looe, Cornwall, Eng.*
S. H. BARTLEY, *E. Lansing, Mich.*
J. O. BAXTER, *Beaufort, N. C.*
R. C. BAXTER, *Warren, Ohio*
N. BIER, *London, Eng.*
A. G. BILLMEIER, *Denton, Md.*
P. BOEDER, *Southbridge, Mass.*
E. E. BRANN, *Independence, Kans.*
C. S. BRIDGMAN, *Madison, Wis.*
L. G. CHASE, *Springfield, Vt.*
M. N. CHODROFF, *Brooklyn, N. Y.*
J. B. CONLOGUE, *Peoria, Ill.*
M. T. EBERL, *Milwaukee, Wis.*
R. EHRENBERG, *Granite Falls, Minn.*
A. B. EMMES, *Castro Valley, Calif.*
H. W. EWALT, JR., *Pittsburgh, Pa.*
W. C. EZELL, *Spartanburg, S. C.*
W. FEINBLOOM, *New York, N. Y.*
I. P. FILDERMAN, *Memphis, Tenn.*
L. E. FIRESTONE, *Detroit, Mich.*
J. H. GROUT, *Raleigh, N. C.*
R. GRAHAM, *Pasadena, Calif.*
R. H. GREEN, *Boston, Mass.*
S. K. GUTH, *Cleveland, Ohio*
H. F. HAINES, *Columbus, Ohio*
R. M. HALL, *Cleveland, Ohio*
S. S. HANIFORD, *Buffalo, N. Y.*
M. J. HIRSCH, *Los Angeles, Calif.*
J. R. HUBBARD, *Cleveland, Ohio*
E. A. HUTCHINSON, *Los Angeles, Calif.*
R. IRVING, *Glasgow, Scotland*
O. H. JOHNSON, *Jonesboro, Ark.*
G. W. KEEVIL, *Toronto, Ont.*
A. S. KITCHEN, *Clearwater, Fla.*
G. W. KNOX, *Columbus, Ohio*
L. H. KRASKIN, *Washington, D. C.*
A. LIT, *New York, N. Y.*
R. S. MANWILLER, *Philadelphia, Pa.*
E. MARG, *Berkeley, Calif.*
E. J. MARGARETTEN, *New York, N. Y.*
R. MARKS, *Rochester, N. Y.*
O. L. MCCULLOCH, *Holyoke, Mass.*
J. W. MOGEY, *Flushing, N. Y.*
H. I. MOSS, *Wilmington, Dela.*
H. G. MOTE, *Columbus, Ohio*
T. J. MURROUGHS, *Chicago, Ill.*
R. NEEDLES, *Chicago, Ill.*
J. NEUMUELLER, *Haddonfield, N. J.*
V. S. NUPUF, *Canton, Ohio*
D. R. PAIKE, *Topeka, Kan.*
G. A. PARKINS, *Ord, Neb.*
J. I. PASCAL, *New York, N. Y.*
J. D. PERRY, JR., *Winston-Salem, N. C.*
H. B. PETERS, *Berkeley, Calif.*
R. A. PHILLIPS, *London, Eng.*
H. E. PINE, *Chicago, Ill.*
C. A. RADDE, *Cleveland, Ohio*
E. E. REESE, *Westerville, Ohio*
E. O. ROLAND, *Brevard, N. C.*
E. LEROY RYER, *New York, N. Y.*
Z. J. B. SCHOEN, *Chicago, Ill.*
W. P. SCHUMANN, *Vineland, N. J.*
C. SHEARD, *Rochester, Minn.*
F. W. SINN, *Philadelphia, Pa.*
W. SMITH, *Boston, Mass.*
D. A. SPRINGER, *Anniston, Ala.*
R. T. TEXTOR, *Cranford, N. J.*
C. L. TRELEAVEN, *New York, N. Y.*
R. W. TUBESING, *Richmond, Ind.*
I. I. VICS, *Albany, N. Y.*
W. G. WALTON, JR., *Merion, Pa.*
G. H. WARKENTINE, *Cedar Rapids, Iowa*
S. G. WEISS, *Torrington, Conn.*
A. P. WHEELOCK, *Des Moines, Iowa*
R. E. WICK, *Rapid City, S. D.*
G. C. WISE, *Hartsville, S. C.*
E. G. WISEMAN, *Buffalo, N. Y.*
J. R. WITTEKIND, *Morrisville, Pa.*
D. WOOLF, *New York, N. Y.*

Published Monthly by the AMERICAN JOURNAL OF OPTOMETRY PUBLISHING ASSOCIATION.
1502 Foshay Tower. 821 Marquette Ave., Minneapolis 2. Minn.

ANNUAL SUBSCRIPTION, UNITED STATES and CANADA $6.00. FOREIGN $6.50
Single copies, 60c

Entered as second-class matter, February 20, 1924, at the post office at Minneapolis 2, Minnesota, under the Act of March 3, 1879
Established 1924

Young and Lovely...

CRESTLINE STARTS ITS SECOND YEAR

Over a quarter of a million women found a fashion friend in CRESTLINE during its first year, 1950.

Thousands of doctors and dispensers not only saw it melt resistance to the wearing of the glasses needed for proper seeing, but were professionally pleased to see its easy adjustability and to find correct optic fitting a simple matter.

Now CRESTLINE starts its second year. Prediction are that its sparkling gold, rich engraving and di tinctive styling will carry it fast and far. Always su gest CRESTLINE when there's a call for fine eyewea

CRESTLINE has a 10K gold bridg
The balance is 1/10 12K gold fille

Continental INDIANAPOLI

AMERICAN ACADEMY OF OPTOMETRY

Dr. Harold Simmerman, *President*
Woodbury, New Jersey

Dr. Robert E. Bannon, *Vice-President*
Hanover, New Hampshire

Dr. Carel C. Koch, *Secretary*
Minneapolis, Minnesota

EXECUTIVE COUNCIL

Dr. Harold Simmerman, *Chairman*
Woodbury, New Jersey

Dr. Robert E. Bannon, *Vice-Chairman*
Hanover, New Hampshire

Dr. Carel C. Koch, *Secretary*
Minneapolis, Minnesota

Dr. D. G. Hummel, *Past President*
Cleveland, Ohio

Dr. Lawrence Fitch
Philadelphia, Pennsylvania

Dr. John D. Perry, Jr.
Winston-Salem, North Carolina

Dr. R. W. Tubesing
Richmond, Indiana

Dr. Ralph E. Wick
Rapid City, South Dakota

EX OFFICIO MEMBERS

Dr. Harold Fisher
New York, New York

Dr. Meredith W. Morgan, Jr.
Berkeley, California

Dr. Arthur P. Wheelock
Des Moines, Iowa

Office: American Academy of Optometry: 1502 Foshay Tower, Minneapolis 2, Minn.

The AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY serves as the official publication of the American Academy of Optometry. It is published monthly by the American Journal of Optometry Publishing Association under the editorial supervision of the American Academy of Optometry.

Publication Office: 1502 Foshay Tower, 821 Marquette Ave., Minneapolis 2, Minn.

AMERICAN JOURNAL OF OPTOMETRY
and ARCHIVES *of*
AMERICAN ACADEMY OF OPTOMETRY

Vol. 28 — No. 2

CONTENTS

ORIGINAL PAPERS

The Problem of Visual Direction. Part I. The History to 1900. Gordon L. Walls 55

Compensatory Torsion and Visual Acuity. William G. Walton, Jr. 84

The Effect of Base-Out Prisms on Eye-Hand Coordination. Neal J. Bailey 87

An Approach to Personnel Problems Through Visual Performance Tests. R. A. Sherman 92

EDITORIALS

Referrals in Contact Lens Cases. Carel C. Koch 96

The 1950 Academy Meeting. Robert E. Bannon 98

TRANSACTIONS OF THE ACADEMY 99

CURRENT COMMENTS 106

BOOK NOTICES 111-114

B&L Zyl

SMART ON WOMEN

Your fashion-conscious patients will appreciate the graceful modern styling of Bausch & Lomb Zyl. Attractive shapes and models, to enhance appearance . . . Lustrous colors to complement any complexion.

B&L Zyl

DISTINGUISHED ON MEN

It's Bausch & Lomb Zyl for bold styling and solid masculine good looks. Contoured for distinction in a variety of styles and colors to blend handsomely with basic face types.

B&L Zyl

THE MODERN EYEWEAR OF ENDURING STYLE . . .

B&L Zyl

MADE BETTER TO WEAR BETTER

✔ **FAMOUS FOR FIT.** Designed for living faces as well as for styleful appearance. Optically correct eye shapes. Wide range of sizes.

✔ **HOLD THEIR SHAPE.** Machine-contoured from fully cured sheet stock, and cured in process, too, to assure accuracy and permanence.

✔ **FIRM HINGES,** force-fitted without need for cement, and perfectly trued, to assure long wobble-free service.

✔ **COMFORT** built in with smooth pads, scientifically designed temples.

✔ **BEAUTY** . . . exclusive B&L three-step polishing process and hand buffing to achieve a deep, lasting lustre.

BAUSCH & LOMB
OPTICAL COMPANY ROCHESTER 2, N.Y.

You're ahead with an

LENSOMETER

in accuracy . . .

LENSOMETER gives the critical accuracy you need over the entire range of measurements.

in dependability . . .

LENSOMETER has the superior design, workmanship, and materials to stand up under long, hard usage that would often cause less accurate devices to become inoperative.

in convenience . . .

LENSOMETER is easy to read, simple to operate, requires no involved calculations.

in versatility . . .

LENSOMETER accommodates high or low Rx in single vision, bifocal, trifocal or cataract lenses.

Only American Optical Company makes the LENSOMETER. For complete satisfaction now and in the years to come, accept no substitutes. A convincing demonstration of LENSOMETER superiority will gladly be arranged by any AO Branch Office.

American Optical
COMPANY

It's an Art Brow TOWNSMAN

a new combination frame—meets all of today's exacting requirements, sound structural design—style, and wearing ease. For your most discriminating masculine patients prescribe Art-Brow "TOWNSMAN", the frame that combines durability and easy fitting with clean bold lines and unobstructed vision plus practical construction.

SIZES: Measured on the Optical Center

	EYE	BRIDGE
SIZES:	42(42x38)	20-24
	44(44x40)	20-26
	46(46x42)	20-26

TEMPLES: 3¼, 4, 4¼, 4½, 4¾, 5

COLORS: Demi-amber — pink crystal — demi-blonde — briartone

STYLED BY

Art-Craft OF ROCHESTER

OFFICES NEW YORK • CHICAGO • PHILADELPHIA

Confidence

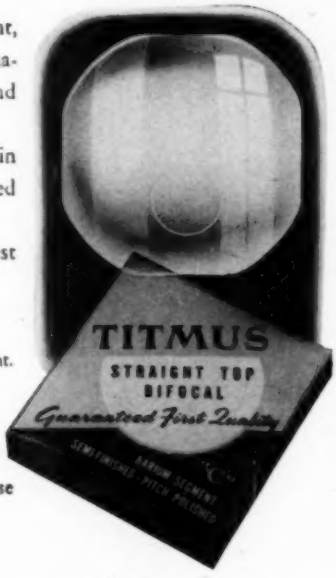
IN YOUR PROFESSIONAL SKILL

Your patients have implicit trust in your judgment, knowing that through your professional skill their examination will result in lenses that provide the most efficient and comfortable vision possible.

The selection of the lenses is an important factor in providing the comfort that inspires the patient's continued confidence.

Titmus Straight Top Bifocals are designed for best visual performance with features that include:

- **MINIMUM IMAGE JUMP**
  Cut-off segment design reduces abrupt image displacement.
- **WIDE READING SEGMENT**
  Provides a wide reading field.
- **FREEDOM FROM COLOR**
  Color in segment reduced to a practical minimum with use of barium glass.
- **PITCH POLISHED**
  For greater accuracy of curvature.
- **LARGE 55 x 60 mm. SIZE**
  Large enough for practically all modern frame shapes.



In White,
Velvet Lite, A & B

TITMUS OPTICAL CO., INC.
Petersburg, Virginia, U. S. A.

This marks the beginning of a new visual life

In Continuous Vision Lenses, doctors at last have a tool which will completely correct the faults of presbyopic vision . . . and which, at the same time, is completely acceptable to those presbyopes.

Ophthalmically, Continuous Vision Lenses will do everything that trifocals would do . . . with the important addition of "patient-appeal." Lenses are only effective if the man or woman who needs them *gets* them. CV'S, because their principle is easily understood by your patients, are being worn by more and more satisfied patients daily.

Technical information demonstrating that presbyopes enjoy complete seeing comfort *only* with lenses of three focal powers is available in "Ranges of Clear and Comfortable Vision with Multifocal Lenses" by V. J. Ellerbrock, Ph.D., and K. S. Zinnecker, B.Sc., Ohio State University. Copy will be sent to you on request.

UNIVIS

THE UNIVIS LENS COMPANY, Dept. P, Dayton 1, Ohio

THEY LOOK YOUNG WHEN THEY SEE YOUNG WITH CV'S!

Housewives

Executives

Dentists

Clerks

RESEARCH KEEPS UNIVIS FIRST

Across three indices of glass:

CURVATURE ACCURACY to millionths of an inch

The Newton's Ring Test:
Univis has used it for years to assure perfect matching of surface curvature in blank and button. Now it produces even more graphic evidence of Univis superiority.

Applied to the entire surface of Univis Continuous Vision Lenses, optical proof plates show Newton's Ring accuracy of surface curvature to millionths of an inch . . . across three indices of glass!

This can be easily translated into better vision for your patients . . . and added to your list of reasons why your prescriptions produce *best* results when filled with Univis Lenses.

THE UNIVIS LENS COMPANY, Dayton, Ohio

CV CONTINUOUS VISION LENSES

UNIVIS VISION EFFICIENCY

1926—A QUARTER CENTURY OF OPTICAL PROGRESS—1951

Announcing Publication of...

STIMSON'S

OPHTHALMIC DISPENSING

Considering the need for a coalition of thought and practice to impart to the refractionist, the student, and the practitioner, a more concise appreciation of both the scope and the limitations afforded by a properly compounded and correctly adapted seeing device—and the need for a scientific approach to this objective—this book is a notable contribution to the literature.

Its value and reward will be its function toward visual perfection in affording an essential background to those who would render adequate service in Ophthalmic Dispensing.

In preparing his manuscript, Stimson constantly considered a pair of spectacle lenses as part of an optical system. On this basis, he has done a book that will be readable and instructive to students in courses in ophthalmic optics in the technical schools, optometry schools, or graduate courses in ophthalmology. It will also be useful to nurses and technical assistants in refractionists' offices.

The chapters on prescription analysis should prove helpful to laboratory technicians as well as to anyone seeking accurate information concerning the application of the several lens forms to prescriptions.

The first four chapters discuss the tools (lenses), foundations and landmarks (patients' features and anatomical measurements involved).

Chapter 5 describes the "ideal" eye and the common deviations that require lens prescription. Chapters 6, 7 and 8 cover the most common prescription problems — both single vision and multifocal — and the means of fitting them properly.

Chapters 9, 10 and 11 consider the unusual cases. In this section you will find the most comprehensive discussion of fitting of cataract lenses in print today.

Chapter 12 contains a large amount of special information on lens analysis that is appearing for the first time.

The balance of the book is devoted to instructions on adjusting and fitting completed glasses and pertinent information needed by master dispensers.

By RUSSELL L. STIMSON, Instructor in Ophthalmic Optics at Los Angeles City College; Member of the American Board of Opticianry. 432 pages, 178 illustrations. PRICE, $8.00.

Order Form

AJO 2-51

THE C. V. MOSBY COMPANY
3207 Washington Blvd.
St. Louis 3, Missouri

Please send me Stimson's OPHTHALMIC DISPENSING ($8.00).

☐ **Enclosed find check.** ☐ **Charge my account.**

Name_____

Address_____

AO ZYLMONT

BEAUTY AND PERFORMANCE COMBINED IN ZYL AND GOLD FILLED

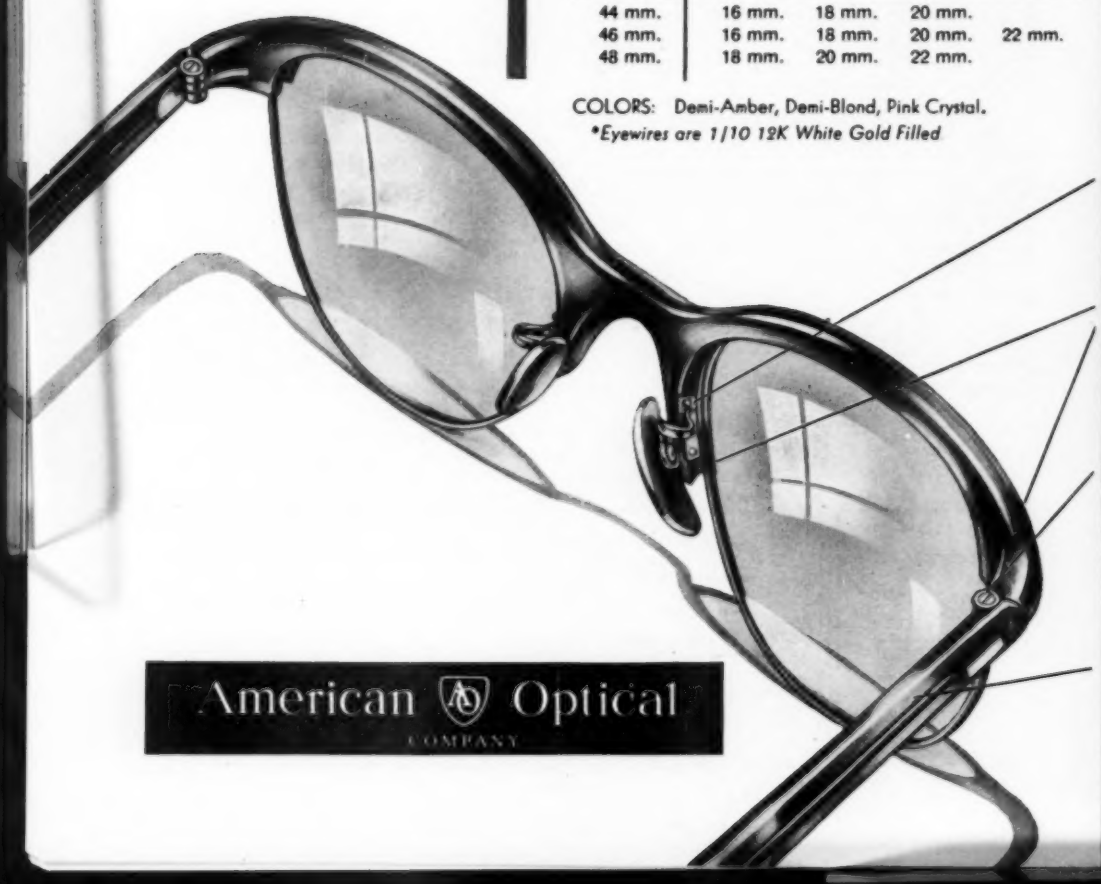
The Zylmont combines many of the cosmetic and fitting advantages of both zyl and gold filled.* It is flattering to men and women—and is supremely functional as well.

Some of its features are highlighted here—to indicate why the Zylmont is the most versatile, most ophthalmically reliable combination frame.

Eye Sizes	*Bridge Sizes*			
44 mm.	16 mm.	18 mm.	20 mm.	
46 mm.	16 mm.	18 mm.	20 mm.	22 mm.
48 mm.	18 mm.	20 mm.	22 mm.	

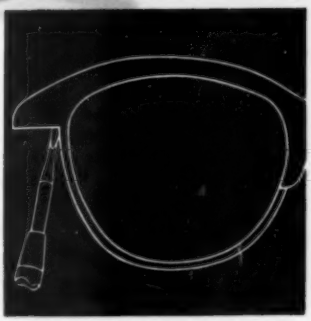
COLORS: Demi-Amber, Demi-Blond, Pink Crystal.

**Eyewires are 1/10 12K White Gold Filled*



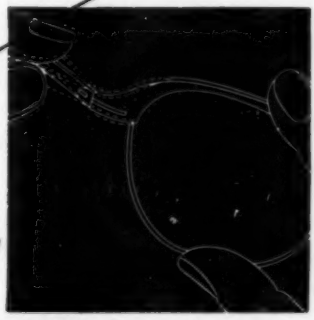
American Optical COMPANY

Ful-Vue

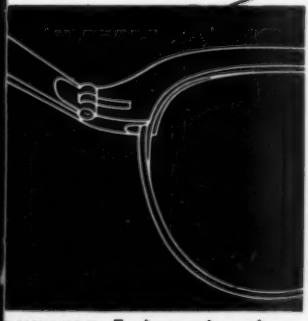


SIMPLE: Normal procedure for lens insertion simply involves removal of one screw to release end of eyewire at temporal side.

VERSATILE: For more difficult prescriptions, eyewire is easily withdrawn by removal of just two screws at nasal portion.



TOUGH: Eyewire fits firmly into recesses at the temporal and nasal sides—but retains a taut flexibility to resist shock.



DURABLE: Exclusive three-barrel hinge construction provides greater holding power and more accurate fitting of parts.

COMFORTABLE: New Contour Temples are easily adjustable for comfort. Tips slip easily through a woman's hair.

WHAT ABOUT CONTACTS?

Properly and judiciously used, the contact lens is a visual aid that merits much consideration. Many patients with keratoconus or monocular (and binocular) aphakia are wearing contact lenses with resulting vision of a grade that would otherwise be impossible. In addition, other ametropes may wear contact lenses while engaging in activity where spectacles cannot be used, or would be a serious disadvantage. An athlete is a vivid example.

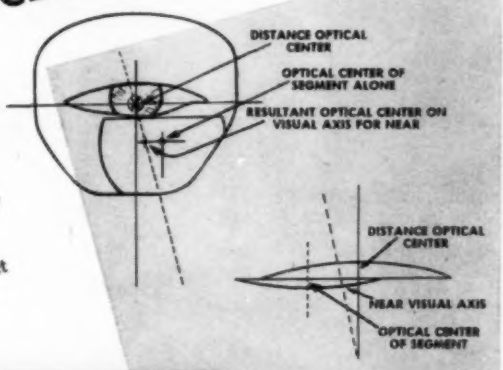
NONSCLERAL (fitting on the cornea only), conventional fluid type, or fenestrated lenses are fitted depending on the patient's needs and requirements. The proper fitting of contact lenses of *any* type requires a great deal of time and care. The patient, beginning to wear contact lenses, should be under frequent observation at first so that improvements in the fit of the lenses may be made if found necessary. Only in this way can maximum wearing time and comfort be achieved.

Interpreting your prescription into glasses that DO what YOU want them to do for the patient is our specialty!

N. P. BENSON OPTICAL COMPANY
Since 1913

MAIN OFFICE AND LABORATORY: MINNEAPOLIS, MINN.
Branch Laboratories in Principal Cities of Upper Midwest

OPTICAL CENTER CONTROL with the CEN-COR BIFOCAL (OR TRIFOCAL)


DISTANCE OPTICAL CENTER
OPTICAL CENTER OF SEGMENT ALONE
RESULTANT OPTICAL CENTER ON VISUAL AXIS FOR NEAR
DISTANCE OPTICAL CENTER
NEAR VISUAL AXIS
OPTICAL CENTER OF SEGMENT

A PRECISION development—created to give your patient relief from discomfort causing Base Out prism at the reading point induced by hyperopic corrections. The CEN-COR may also be used whenever a large segment area is desired. For further information contact your supplier or write direct.

PRECISION-COSMET Company, INC.
236 HENNEPIN AVENUE GATEWAY BANK BUILDING
MINNEAPOLIS 1, MINNESOTA

AMERICAN JOURNAL OF OPTOMETRY
and ARCHIVES *of*
AMERICAN ACADEMY OF OPTOMETRY

Vol. 28 February, 1951 No. 2

THE PROBLEM OF VISUAL DIRECTION*

PART I. THE HISTORY TO 1900†

Gordon L. Walls‡
School of Optometry, University of California
Berkeley, California

INTRODUCTION

There is a certain question that comes to the mind, if not indeed to the tongue, of practically every person who has just learned a little about the structure of the eye and the process of vision. It is a question that was first asked at about 1600 A.D., has been asked thousands of times since, and will be asked (and patiently answered by numberless teachers) until the end of mankind. There have been several answers to it, and each answer is believed today by some number of people. Paradoxically, we can all agree that it is as foolish a query as ever was raised in any field of science—and yet, however one chooses to answer it, it has implications which are as important to the whole philosophy of present and future optometric practice as is anything.

The question is, how is it that we see things "right-side-up" when their images on the retina are "inverted"? Any one of us *could* answer somehow, in a hundred words or less. I shall spend thousands of words on the matter, in three installments. To make sure of being heard to the end of the third paper in this series, I shall run ahead in the story to point out why I think this question so important to the profession of optometry: It is because if we pin our faith to one kind of answer we shall have to consider that there are bounds—and fairly narrow ones—to what we can expect to accomplish for certain kinds of visual

---

*Submitted on October 10, 1950, for publication in the February, 1951, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY. Read in condensed form on the educational program of the 45th annual convention of the California Optometric Association (Santa Cruz, February 19, 1950).

†Part II of this paper, "The Tangible Basis for Nativism," will appear in the March, 1951, issue. Part III, "Experimental Attacks and Their Results," will appear in the April, 1951, issue.

‡Member of faculty, Sc.D., Fellow, American Academy of Optometry.

disorders by educatory or re-educatory procedures. Whereas, if we believe in another kind of answer, we shall be led to think that "the sky is the limit" for the alteration of modes of visual perception by attempts at training.

You realize at once, of course, that the two rival answers I allude to are the "nativistic" and the "empirical" ones. We do not, here, have to make any choice between the whole of the nativist position and the whole of the empiricist position with regard to the whole of space-perception. Any modern author who fairly reviews the entire grand controversy will conclude by saying that some elements in perception are innate and some are acquired in experience, by learning, conditioning, association, or what you will. I agree, of course. But as concerns erect vision with an inverted retinal image, and left-right vision with a right-left image, there can be no middle ground and no Roman riding on two horses. Either this mode of visual perception is innate, or it is learned; and it is either immutable, or it is alterable. The native-empiric debate is nowadays called dreary by those who do not realize that our two surviving "schools" of psychology, Gestaltism and logical positivism, are respectively nativistic and empiricistic.[1] I shall try very hard to keep the little fragment of the argument, chosen here, from seeming dreary or an anything-like-dead issue!

If from birth we see things as having the same orientations with respect to ourselves that they have for us as adults, then the "erectness" feature of perception is innate. This may be shown to be due to built-in anatomical provisions in the nervous system of vision. These provisions might or might not be found to preclude any possibility of educatory tampering. On the other hand, the very latest textbook of experimental psychology (Postman and Egan, 1949) assures us in so many words that an infant has to learn to see things right-side up. Every one of the textbooks in use today which have "physiological optics" in their titles —Helmholtz (1925), Southall (1937), Zoethout (1947)—gives aid and comfort to the thoroughgoing empiricist in this connection. Optometrists have been asked for some time, and no doubt will be asked for some time to come, to believe that we learn to see right-side-up. There have been persons who could remember the experience of being born—but, strangely, none who could remember having seen things as up-side-down or no-way-up-at-all before he saw the same things as right-side-up. However, the ultra-modern visual empiricist even believes that if one's retinal images are artificially re-erected by optical devices, one

[1]And, of course, essentially the same controversy lived on as "heredity versus environment" for the post-Darwinian biologists; and, in the guise of "nature versus nurture" it is very much alive today among our "social" scientists.

may "learn" in a few days to *see* the contents of the visual field oriented just as they were before the device was ever worn.

And, here is the crux of the matter and the basis of its *practical* importance. For, *if* the major miracle of learning to see an object as erect, when its retinal image is also erect, is possible, then one must be prepared to believe that all sorts of *lesser* restructurings of the perceptual visual field should be possible and easy, and almost any sort of "training" may be worth urging upon the patient. But if this magic turns out to be an illusion and its prophets false, then conservatism recommends itself.

THE ORIGINAL QUESTION

The history of our simple question has had several epochs: a period of blissful ignorance, one of shock and bewilderment, a period of general satisfaction with empiricism, and one which saw the rise of strong nativism and a lengthy controversy between the opposed points of view. The last three decades have brought neuroanatomical sophistication—but not on the part of those most interested in the erectness question: *they*, even today, look back to the arguments of the nineteenth century, and settle themselves into the past, in whatever period of satisfaction suits them. The ultra-modern empiricist is not only wretchedly ignorant of the structural provisions of the central visual system, but speciously advances old arguments that had been promptly shown to be fallacious even when they were fresh.

The earliest ideas about the nature of vision did not contain the problem of erect vision. Aristotle, Democritus, and Epicurus got the light rays turned around so that they traveled from the object to the eye, and not in the reverse direction as the Pythagorean and Stoic philosophers supposed them to do. But the object was believed to emanate *eidola*—little replicas of itself which, impinging upon the eye, led to perception. The real object, and the replica "painted on the eye," and the percept all having the same orientation, there was no problem. There was complete isomorphism—identity of shape (and position)—from step to step of the visual process. The ancients would probably not have been much disturbed by knowledge of the optical inversion of the ocular image, for their philosophy was an empiricism capable of coping with anything, however "anomalous": the infant "mind" was a *tabula rasa*, a blank plate of wax upon which the moving finger of experience wrote the entire eventual content of consciousness and memory.

At an undetermined time in his life, Leonardo da Vinci (1452-1519) wrestled with the dioptrics of the eye. He was quite sure that the retina was the essential sense organ, not the crystalline, as had been

generally thought earlier. He drew diagrams of the eyeball and tried to trace rays through its media to their formation of an image on the retina. The image persisted in coming out inverted, which to da Vinci—with 20 centuries of isomorphism looking down upon him—was unthinkable. So, he tried several ways of securing a first focus within the cornea and a second one within the lens, or a first crossing in the lens and a second in a supposed lens-like core in the vitreous, etc. At least three of his schemes for obtaining an *erect* retinal image seem to have partially satisfied him, for he let them stand in his notebooks (see Polyak 1941, Fig. 24).

Da Vinci's ideas were not available until long after his death: but in the meantime Francisco Maurolycus, whose *Photismi de Lumine et Umbra* (1554) had several editions and wide circulation (and has lately been translated afresh: Maurolico, 1940), also tried to puzzle through the formation of the intraocular image. He, too, rejected the idea that the image *sensed* could possibly be inverted, but he could not see how the retinal image could be otherwise: so, he decided that the function of the retina must be nutritive, and placed the locus of reception in the lens itself. Giambattista della Porta, who well understood—although he did not invent it—the *camera obscura* (which survives in the form of the pin-hole photographic camera[2]), compared the eye to this device in a late edition of his *Natural Magic* (1558 *et seq.*; Polyak, 1941). Knowing the camera image to be inverted, della Porta might have been disturbed by his own conclusions about the ocular image; but, he thought this was sensed by the lens.

It remained for Plater (1583) and Kepler (in 1604 and 1611) to be the first to draw reasonably accurate diagrams of ophthalmic optics, and to be the first to become certain—on paper—that the retinal image was inverted. Absolute proof came shortly, when Pater Scheiner (in 1625) was the first of many to *see* the retinal image from the exterior of an enucleated eyeball, in the fundus of which he had cut a scleral window.

Bewilderment was intensified, for Kepler had raised the question we are dealing with here, but had offered no answer whatever to it. Isomorphism had been assumed for so long that now, with the *tabula rasa* concept of the mind largely abandoned, erect vision with an inverted image seemed anomalous. It was rather the assumption of isomorphism that should have seemed false—whereupon the erectness of vision would have been accepted as normal and there would not have seemed to be a "problem" at all (Hyslop, 1897b). Instead, an anomaly, demanding

[2]And in at least one full-sized example, lately built in San Francisco to enable tourists to view the Seal Rocks.

"explanation," seemed to inhere. The spread of information was not rapid in the scientific world of the time, however. Attempts to erect the retinal image by an imagined second refraction continued to be made for a long time by those who had not heard of Scheiner's experiment (e.g., Santorio, in 1660).

There were also those who could admit that there was an image on the retina and that it was inverted, but could think that what was sensed was not this image but an erect one in the cornea, in the lens, or in the vitreous. In some schemes the retina was a concave mirror and the image formed upon it was thrown forward to be sensed elsewhere in the eye. This optical chaos extended halfway through the nineteenth century, for it was not ordered until Gauss' general theory (1841) was applied to the eye by Moser (1844) and Listing (1845), with the system of ophthalmic optics finally becoming something like definitive through the work of Helmholtz in 1856-1866 (see Duke-Elder, 1946, p. 731).

DESCARTES—A PREVIEW

An important step was taken, nearly 300 years ahead of its time, by René Descartes. He was one of those who duplicated Scheiner's direct observation of the inverted image upon the exposed retina, of a bull's eye, and reported this in his *Dioptrice*, published in 1637. Descartes was not stumped. For his *Tractatus de Homine* (published in 1664, 14 years after his death), Descartes made an elaborate drawing showing an external object, its reverted images on the retinas, and the brain (see reproduction by Polyak, 1943, as his Figure 53). He showed the optic-nerve fibers terminating within the brain, with a new set of connections then running to the pineal body (which, because it is unpaired, Descartes believed to be the locus of the mind). These latter connections were *decussated*, so that the final image formed in the pineal body for the soul to contemplate would be *erect*. Of course Descartes' hypothetical diagram was wrong in almost every particular. But this does not make it ludicrous. Descartes was the first to postulate a kind of *anatomical* "isomorphism" that we know, today, does exist (a second bull's-eye for Descartes!). This is the point-for-point representation of the topography of the retina (and of any image on it) at every synaptic level within the central visual system, with precise localization of anatomical *retinal* points in other anatomical points in the sensory cortex (and even in the "perceptual" cortex of Brodmann's Area 19).* With respect to the perceptual visual erectness of objectively erect objects, Descartes

*The system of cerebral representation of the retina will be dealt with in the second paper of this series.

was thus able to be the first thoroughgoing nativist in history.

THE HEYDAY OF BRITISH EMPIRICISM

The first sensory empiricist of modern times was a contemporary of Descartes, Thomas Hobbes ("There is no conception in man's mind which hath not at first, totally or by parts, been begotten upon the organs of sense;" *Leviathan*, 1651). A greater name is that of John Locke, who, in his *Essay Concerning Human Understanding* (1690), set forth a system in which all native knowledge was denied and all ideas were the result of experience, in which the concept of a thing was built by the association of acquired visual, tactual, auditory, etc., experiences of it. To all intents and purposes, Locke revived the *tabula rasa*. Other British "associational" and "sensational" empiricists were David Hume (*Treatise on Human Nature*, 1739; *Inquiry Concerning Human Understanding*, 1748), David Hartley (*Observations on Man*, 1749), and the three great Scots, Thomas Reid (*Essays on the Intellectual Powers of Man*, 1785), Dugald Stewart (*Elements of the Philosophy of the Human Mind*, 1792-1827), and Thomas Brown (*Lectures on the Philosophy of the Human Mind*, 1820). All of these men could properly be called *the first psychologists*. Historically, then, the earliest viewpoint upon visual space-perception, in formal psychology, was strictly empirical. Helmholtz was later to be the great champion of this general viewpoint—and his contemporary Ewald Hering, (with whom Helmholtz rarely saw eye to eye about anything) was to be the first great nativistic psychologist.

Now, the most conspicuous (still!) of the British empiricists was George Berkeley, sometime Bishop of Cloyne. Although Berkeley's *Essay Towards a New Theory of Vision* was published in 1709, people are still talking about it. Even so great a modern authority as E. G. Boring (1942; p. 224) says that Berkeley had "the right answer" to the question of erect vision with an inverted image. We shall have to look closely at what Berkeley had to say that bears upon our question. For, as we shall see later, when our ultra-modern empiricists appeal to the experiments of George Stratton, they are actually appealing to the ghost of George Berkeley.

BERKELEY

Berkeley raises the question in his Section 88, by saying: ". . . there occurs one mighty difficulty. The objects are painted in an inverted order on the bottom of the eye: the upper part of any object being painted on the lower part of the eye, and the lower part of the object on the upper part of the eye: and so also as to right and left. Since therefore the pictures are thus inverted, it is demanded how it comes to

pass, that we see the objects erect and in their natural posture?" In the next section, Berkeley sets forth an explanation which he credits to William Molyneux (1692), and which was generally accepted at the time. This was a question-begging, nativistic statement which, in various guises, is always actually "the law of visible direction" embedded in the literature of the whole 19th century: A ray of light that strikes the upper half of the retina is "considered" by "the mind" as coming from the lower part of the object, and vice versa; so, "the mind . . . is directed to make a right judgment" of the orientation of the object, despite the inversion of the retinal image. Here "the mind" is conceived as a reasoning homunculus perched within the brain and able to look at the retinal image. It is impossible, nowadays, to trace the first formulation of the "law of visible direction" to any one person—but the essence of it was certainly in the mind of Descartes, if not also in that of many another post-Keplerian before Molyneux.

In Section 90, Berkeley attacks Molyneux's treatment on the ground that no one is aware of the light-rays, their crossings within the eyeball, etc.; and, *without* such awareness there could be no "judgment" of orientations by means of such awareness. Section 91 promises a better answer to the erectness question, the key to which lies in the relations of vision and *touch* (which I shall use here as a short term for the synthesized tactual and kinaesthetic modes of perception). Berkeley (Section 93) says: "It is certain that a man actually blind, and who had continued so from his birth, would by the sense of feeling attain to have ideas of upper and lower. By the motion of his hand he might discern the situation[3] of any tangible object placed within his reach. That part on which he felt himself supported, or towards which he perceived his body to gravitate, he would term lower, and the contrary to this upper; and accordingly denominate whatsoever objects he touched." For this congenitally-blind, "erect" would mean "nothing more . . . than that perpendicular position of a man, wherein his feet are nearest to the earth" (Section 96)—a fact which touch alone would ascertain. "But if we suppose him on a sudden to receive his sight, and that he behold a man standing before him, it is evident, in that case, he would neither judge the man he sees to be erect nor inverted; for he never having known those terms applied to any other save tangible things, or which existed in the space without him, and what he sees neither being tangible, nor perceived as existing without, he could not know that in propriety of language they were applicable to it."

So far, so good. It is certainly true that Berkeley's man would

[3]For Berkeley's "situation," read *orientation* throughout this discussion.

have to *learn* to *call* one end of a vertical object "upper" and the other end "lower." And, for the congenitally-blind man given sight surgically we may as well read *any growing child;* for, every one of us had to learn the usage of "up" and "down" as words. We all have to learn the name "red" *for* red and the name "pink" *for* pink, but this does not mean that we have to learn to see them as differing, and as differing in a certain way, with this way miraculously the same way for all of us. But Berkeley leads his ex-blind man *around* this and says (Section 97): "Afterwards, when by turning his head or eyes up and down to the right and left, he shall observe the visible objects to change, and shall also attain to know, that they are called by the same names, and connected with the objects perceived by touch; then, indeed, he will come to speak of them and their situation, in the same terms that he has been using to apply to tangible things: and those that he perceives by turning up his eyes, he will call upper, and those that by turning down his eyes, he will call lower." In the following Section (98), it is claimed that: "And without this motion of the eye, this turning it up or down in order to discern different objects, doubtless, erect, inverse, and other like terms relating to the position of tangible objects, would never have been transferred, or in any degree apprehended to belong to the ideas of sight: the mere act of seeing including nothing in it to that purpose; whereas the different situations of the eye naturally direct the mind to make a suitable judgment of the situation of objects intromitted by it."

Here is a clear statement, in its earliest form, of what later came to be called "the eye-movement theory" of the erect-vision problem (and of all visual localization). Berkeley is saying that the man will learn to apply, to his visual experiences, terms from his more basic, tactual, terminology, in accordance with the eye-movements he learns to be correlated with those visual experiences. I submit, however, that if the hypothetical ex-blind man were ordered to keep his eyeballs motionless when the bandages were removed, he could quickly learn the meaning of "up" and "down" in his new visual perceptual modality. I, as experimenter, would take his hand and place it first on the top and then at the bottom of some object tactually familiar to him, within the field of his motionless eye. I would tell him which was which, and (even without fixating it) he would see his hand (which I would identify for him) successively apposed to what he knew (tactually) to be the top and bottom. I would be disappointed in his intelligence, if he did not then know which was the top and which the bottom end of anything else he was shown, whether he could name the object (without handling it) or not. All this, mind, without *allowing* eye movement!

Even if the eye-movement theory were to be taken seriously, Berkeley's version of it will not do. There is no conscious eye-muscle kinaesthesia. An upward turning of the eye is not *felt* to be a movement against gravity: and an upward turning to bring an "up" point onto the fovea,[4] while idiomatically called "visual prehension" (grasping) even today, is *not* a tactual operation. We do not sense slow movements of the eyes at all, we sense quick ones but not *as* movements, and we sense the direction of an eye-movement only if it is extreme and vigorous—and then we sense it through localized pain. If Berkeley's ex-blind man were to direct his eyes to an "up" visual point, by a movement which he felt to be an "up" movement (e.g., a head movement), then he would have had to see the point *as* "up" in order to make the movement. The direction of the movement would be determined by a precedent perception—necessarily, visually *given* and not learned—of relations which the theory claims are learned through the movement. So, the theory begs the question. Hyslop (1897b) perceived this, even for the later version of the eye-movement theory that entered into R. H. Lotze's (1852) theory of "retinal local sign"—a version that requires no eye-muscle kinaesthesia and is perfectly compatible with our very modern "innervation sense" (which we owe directly to Helmholtz). It was not for anything we have heard from Berkeley thus far, that Boring commended him.

Berkeley goes on (Section 99) to say: "Further, when he has by experience learned the connection there is between the several ideas of sight and touch, he will be able, *by the perception he has of the situation of visible things in respect of one another*, to make a sudden and true estimation of the situation of outward, tangible things corresponding to them. And thus it is, he shall perceive by sight the situation of external objects, which do not properly fall under that sense." Here, again, Berkeley does make a statement which we can paraphrase into something still acceptable: the ex-blind man, having learned to name visual "ups" correctly from his foreknowledge of tactual "up," can now name the tops and bottoms of things which he can see but cannot touch (i.e., reach). But in the words which I have italicized, Berkeley reveals that he has to accept, as native, the visual perception of the spatial relations of objects in the visual field *to each other*. His subject, then, needs to *learn* nothing whatever more than which visual direction to *call* by the name "up," and which by the name "down!" There is still nothing here for a modern to applaud; but, farther on, in Sections 113-116, he

[4]In the first place, how is this an *upward* movement of the eye? Because the cornea moves upward? But the cornea is not the sense-organ. The *retina*, here, moves *downward*.

has something cogent and important to say, which has nothing to do with eye-movements, and even takes the erectness problem quite out of the native-*vs.*-empiric framework. It is *this*—Berkeley's recognition of "the relativity of space"—to which Boring nods agreement. Let us examine it:

"The head (of the man viewed by the ex-blind man) which is painted (on the retina) nearest the earth, seems to be furthest from it: and on the other hand, the feet, which are painted furthest from the earth, are thought nearest to it. Herein lies the difficulty, which vanishes if we express the thing more clearly and free from ambiguity, thus: how comes it that, to the eyes, the visible head, which is nearest the tangible earth, seems furthest from the earth, and the visible feet, which are furthest from the tangible earth, seem nearest the earth. The question being thus proposed, who sees not the difficulty is founded on a supposition, that the eye, or visive faculty, or rather the soul by means thereof, should judge of the situation of visible objects, with reference to their distance from the tangible earth? Where as it is evident the tangible earth is not perceived by sight." (Section 113, in part.)

"If we confine our thoughts to the proper objects of sight, the whole is plain and easy. The head is painted furthest from, and the feet nearest to, the visible earth: and so they appear to be. What is there strange or unaccountable in this? Let us suppose the pictures in the fund of the eye, to be the immediate objects of the sight. The consequence is, that things should appear in the same posture they are painted in: and is it not so? The head which is seen, seems furthest from the earth which is seen: and the feet which are seen, seem nearest to the earth which is seen. And just so they are painted." (Section 114).

"But, say you, the picture of the man is inverted, and yet the appearance is erect: I ask, what mean you by the picture of the man, or, which is the same thing, the visible man's being inverted? You tell me it is inverted, because the heels are uppermost, and the head undermost? Explain me this. You say, that by the head's being undermost, you mean that it is nearest to the earth: and by the heels being uppermost, that they are furthest from the earth. I ask again, what earth you mean? You cannot mean the earth that is painted on the eye, or the visible earth: for the picture of the head is furthest from the picture of the earth, and the picture of the feet nearest to the picture of the earth: and accordingly the visible head is furthest from the visible earth, and the visible feet nearest to it. It remains, therefore, that you mean the tangible earth, and so determine the situation of visible things with respect to tangible things: contrary to what hath been demonstrated . . . The two

distinct provinces of sight and touch should be considered apart . . ." (Section 115, in part.)

Finally, in Section 116, Berkeley makes plain how *he* defines "erectness": if, when we look at a man, we see the man's feet in contact with the earth, then we are seeing him as erect. The position of the image on the retina is not of the slightest consequence, for in that image the feet and the earth will always be in visual contact. The clear implication, from this and from Berkeley's unacknowledged consideration of tactual localization as primary (if not indeed innate), is that it should be possible, say, to rotate the retinal image 180° by means of an optical device, in an ex-blind man (or in an infant—perhaps, in *anyone*): and, the education or re-education of vision by taction would lead the individual to perceive just like the rest of us. *Feeling* an object to be erect, and *seeing* it to be erect (under Berkeley's definition!), he would perceive the object as "erect, period."

EVALUATION OF THE BERKLEIAN VIEWPOINT

We may concede at once that Berkeley is right in saying, in a roundabout way, that one has to learn the usage of the words "up" and "down" to describe how one is seeing; but that is not a learning to *see* in a particular way. Berkeley's version of the eye-movement theory is untenable, and he has to assume the innateness of perception of the positions, relative to each other, of the things in the retinal image—he assumes, as native, what I shall later be calling *oculocentric directionalization*.

Berkeley allows "touch" and tactual-kinaesthetic localization to be the standard of what is natural, and supposes that visual localization becomes educated by pre-existing tactile localization. This reduces to a transfer of terms from one context to another.

He defines uprightness, visual or tactual, as a conception given separately within each sensory modality by the finding of an apposition of the representations of the earth and of the bottom of the object. His spatial relativity means that if an object has this kind of uprightness, tactually and (simultaneously) visually, then there is no anomaly and no problem. And, such simultaneity is inevitable (regardless of the orientation of the image on the retina), once the education of vision by touch has been accomplished. So, the "inversion" of the retinal image is of no consequence.

We may concede that for anything that could be called normal vision, the visual and tactual localizations of an object must be in agreement. Now, if both of these kinds of localization are innate, their agreement must be innate and unalterable. I shall anticipate a little,

and say here that we know that they cannot *both* be innate.

If neither is innate, then they could theoretically come into agreement in either of two ways. That is, there could be two classes of people, about equal in numbers, each of which in terms of the other would see and feel inversely—but then, the argument is, everything would have Berkleian uprightness for everybody, and there would be no way to identify members of the two classes.

If one of the two modes of localization[5] is innate and the other is learned, then which is which? Berkeley assumes taction to be primary, with vision educated to agreement with taction. If however, we, to-day, can find ponderous reasons why visual localization should be innate, and/or if we find that tactual localization can be changed and visual cannot, then Berkeley was less than half right. We could salvage only his claim that visual and tactual localizations come into agreement empirically. But if vision is the native mountain and taction is the empiric Mahomet, then Berkeley was claiming that the mountain comes to Mahomet.

Berkeley may have hoped that none of his readers, interested in the upright-vision problem, would snoop around among his writings at any distance from his specific discussion of that problem in Sections 88-116. But even his admirer, Boring, points out (1942, pp. 223-4) that Berkeley's theory of the perception of distance involved the assumption that the observer has immediate awareness of the size of the retinal image. This is, of course, nonsense—but Berkeley can be pinned down with it: If retinal image size is "given," then so is retinal-image *shape*, for a shape is a cluster of sizes of dimensions. Immediate awareness of shape would give, or would *be*, immediate awareness of orientation. The shape of the retinal image of an erect man would be natively appreciated as entirely different from the shape of the retinal image of an upside-down man.

Berkeley gets himself even more tightly in a corner in his Sections 74-75. Here he is discussing the age-old problem of why the moon looks so much bigger at the horizon than when it is at the zenith. He claims that the purely visual size of the moon is actually *less* horizontally, and he denies that the horizontal moon *looks* any larger than the meridional moon—it only "suggests a different tangible extension." So, again, touch is the standard and the visual mountain must come to the tactual-kinaesthetic Mahomet: ". . . in any act of vision, the visible

[5]It will be noticed that *auditory* localization is not being mentioned here at all—not that it does not enter into the upright-vision problem in an interesting way, but because I feel that I have ample ammunition without it. Anyone interested should read Ewert (1930) carefully.

object absolutely, or in itself, is little taken notice of, the mind still carrying its view from that to some tangible ideas, which have been observed to be connected with it, and by that means come to be suggested by it."[6]

The good bishop's spatial-perceptual relativity was in no way essential to his out-and-out empiricism. For although Johannes Müller is one of the candidates for the title "first nativist" (with his law of specific nerve "energies"—1826), *he* held the same relativity-concept, and in 1838 said that the mind directly perceives the spatial relations of the retinal image, because these relations are preserved in the arrangement of the optic nerve fibers with which the mind has a direct apprehending contact. "That the retinal image is upside down caused Müller no trouble, for the spatial relations within an inverted image are, of course, identical with those of the erect image" (Boring, 1942, p. 29). Müller's (1835-1840) own words were: *"Even if we do see objects reversed,* the only proof we can possibly have of it is that afforded by the laws of optics: and if everything is seen reversed, the relative position of the objects of course remains unchanged" (italics mine, GLW). Müller *did*, then, apparently conceive that each "nerve fiber" connotes an *absolute* locus (direction, rather) in subjective space. I do not believe that Müller would have expected to "learn over again" to see right-side-up if his retinal image had been artificially re-erected by means of an extrinsic optical device.

THE SECOND QUESTION

Perhaps I am presumptuous in my dismissal of Berkeley. So, I will let Boring (1942, pp. 223-225) explain why he thinks Berkeley "had the right answer."

The question as to "why we see rightside up when the image is upside down . . . is, to be sure, a pseudo problem, for 'up' and 'down' and 'right' and 'left' have no meaning in the image except as it is brought into relation with something else, with the object imagined or with the real retina, since the mind does not see the object. It sees its image; nor does it see the retina when it sees the image." Farther on:

"The problem of the inversion of the retinal image shows a conflict between two points of view, the old and the new, regarding perception. Astonishing to modern psychologists is the length of time it took for the new view to prevail. . . . The older theory of perception regarded the mind . . . as a personal entity within the head . . . perceiving the repre-

[6]In this place, to maintain his position that touch is the standard for all spatial perceptions, Berkeley even has to speak of a tangible extent as a *real* extent. This is a crashing lapse from his whole "idealistic" philosophy, which was that nothing has real existence but is only an idea in a mind—human, or divine.

sentatives (images, copies) of objects that the nerves bring to it. This was the common-sense theory: a cranial homunculus able to perceive directly. . . . The mind . . . would see the image *on the retina* and would see it inverted because it *is* inverted. Thus, since the mind does see objects without inversion, there was a problem.

"The newer theory held that the mind knows only what comes to it in sensation. The mind sees the image, but not on the retina. The image in itself is perceived neither as erect nor inverted. If by *erect* we mean that the tree's branches are near the sky and its roots at the ground, then the retinal image of a tree is erect when its imaged branches are near the imaged sky and its imaged roots at the imaged ground. To say that the image is inverted would be to know the relation of the retinal image to the actual external object of which it is an image, or to the real sky and the real ground, and this relation of the image to the world which it images has been known only to natural philosophers who lived after Kepler's time. . . . Berkeley made this principle of relativity . . . explicit. The retinal image, he argued, is not in itself inverted, for all high objects lie in one part of it and all low objects in the opposite part of it. . . . So the final solution of the problem lay in the recognition of the relativity of space, but it took a long time for the solution to prevail over the popular theory of the absolute perceptions of the homunculus within the head. (*Cf.*, pp. 237*f*.[7])"

If the viewpoint of Berkeley, Müller, and Boring (to skip over Stratton for the time being) is correct, then the problem of "why we see rightside up when the image is upside down" is a pseudo problem—or, if it is a real problem, then it has been solved anyway and pure empiricism wins again.[8]

Very well. We may listen with one ear to this claim. But we should listen with the other ear to Hyslop in his prompt attack (1897 a and b) upon Stratton's understanding of his own (Stratton's) problem: it is not actually necessary to use the words "upright" or "erect" at all in these discussions, but there must be some law that either explains the inverseness (*per se*) between retinal image and percept or else proves the inverseness anomalous.

The "pseudo problem" is, then, exchanged for a very real problem. The question becomes: *Is the natural optical inversion of the retinal image necessary, essential, for upright vision—i.e.*, the visual perception

[7]This reference is to Boring's discussion of Stratton's experiments—his recognition of the relativity therein demonstrated will seem important later.

[8]It should perhaps be noted that Boring labels himself a "logical positivist." No thorough Gestaltist could accept his viewpoint here. I, however, do not propose to offer any Gestaltist arguments.

of common-place objects as being right-side-up with respect to the self?

To approach this question intelligently, we need first to understand thoroughly the development of the conception of "retinal local sign," one version of which in the mouth of that arch-nativist, Hering, gave an emphatic "Yes!" to the clear question that we now see through this gloom of words. The ultra-modern empiricist says "No!" to the question, and even claims that the "no" has been experimentally proved by Stratton and again by Ewert.

BEGGERS OF THE QUESTION

For many centuries, all that was known to comprise the visual system was the eyeball, its muscles, and the optic nerve and tract that disappeared into the wholly mysterious brain. It is not surprising that under the influence of this knowledge—or rather, ignorance—ideas about vision tended to be circumscribed by what could be seen or imagined to take place within the orbit and its contents. With the polishing of the optics of the eyeball during the nineteenth century, the revealed near-perfect isomorphism of the retinal image and the external percept—except for their "inverse" relationship—made it easier than ever to think of the retina as the whole of the visual "sensorium." The problem of spatial localization became entangled and confused with the geometrical-optical relations of the object, the parts of the eye, and the retinal image. Consciously or unconsciously, men fell into the trap set by the axiomatic "reversability" of a light-ray traveling through an optical system. The erect-vision problem seemed, to many, a simple optical problem, or at most a merely physiological problem. These thoughts found expression in two "laws" which have had a very long history, and still "explain" erect vision satisfactorily for many people who should know better.

These laws were the *law of projection* and the *law of (visible) direction*. The first is a simple dogmatic statement that the mind receives impressions from the stimulation of the retina, and projects them into space. The second states just how this projection takes place in order to create an erect percept from an inverted retinal image.

The original notion behind the law of projection should perhaps be credited to Leonardo da Vinci. Its beginnings are really "lost in antiquity." The law of direction could not have been formulated before Kepler (1611), but I have not been able to trace its inventor. By the middle of the eighteenth century, there were already arguments regarding just how the law of direction should be expressed.

The idea of "projection" is quite easy to attack — now. We no longer think of the mind as a tiny entity that sits in the brain reading

messages from the sense-organs like a teletype operator. We know that we are not aware of our retinal image or of the retina. A child is not even aware of the whole eye, except "by accident." We do not have any visual impressions *within* ourselves, which have to be projected. There is nothing to *be* projected: and, there is no empty visual space into which *to* project anything. Although the innateness of the concept of spatiality has been considered one of the "givens" ever since Kant, the ordering and the occupation of visual space is by the things we see in it. If these things are projected, then, necessarily, so is the space. No, we have no visual impression that is detached from, or in any way different from, the visual percept—the thing-as-perceived, and where-perceived, which we take to be the *real* object until we are taught better. The location of the percept is as immediate as the percept itself.

Pretending that there *is* a "projection," let us look now at the law of direction. We cannot dismiss it abruptly just because it implements a non-existent process, for it survives its parent law and reappears later in other costumes as retinal local sign and as oculocentric directionalization.

The law of direction originated as an explanation of a group of phenomena which, while mostly visual, have nothing to do with the commonplace situations in which there is an object and simultaneously an inverted retinal image thereof. A version of it, perhaps much older than any vision-version, is the "law of eccentric projection" in connection with tactual sensation: If I close my eyes and drop a small object, such as a paper clip, upon my upturned palm, I can judge its location and orientation with surprising accuracy. The tactual sensations, that "outline" the object, are projected perpendicularly (i.e., "eccentrically" in an older vocabulary) from the skin.

In vision, "proof" of a similar law of projection of the retinal image, "perpendicular to the surface of the retina," is usually offered by allusion to the visual phenomena which seem to illustrate it without seeming to involve an image—such things as pressure phosphenes, afterimages, Purkinje's vessel-shadows, and the pinhole-and-pin-shadow phenomenon. The first two of these categories have been known since long before Kepler produced the problem which they have been used to "solve":

If, with a fingertip, pressure is exerted through the lids upon the eyeball at the outer canthus, a luminous circle is seen. The apparent distance of this is indefinite, but its direction is toward the opposite side of the face. This direction is the same as that of any percept given by stimulating the same (temporal) spot of the retina with light, "in

the usual way." If a strong light-stimulus is kept imaged on one retinal spot, either central or peripheral, for a few seconds and then removed, one sees an after-image. This will be seen in the same direction as the inducing stimulus unless the eye moves, whereupon the image will "travel with the eye," retaining its direction relative to the retinal spot concerned. If, with a small intense beam of light thrown through the sclera, the larger retinal vessels are caused to cast shadows upon the visual-cell layer, the pattern of these shadows is perceived in external space but is "inverted." If one looks at a pinhole in a card held a few inches from the eye and toward a light, and holds erect a common pin close to the cornea, the erect *shadow* of the pin on the retina is seen as an inverted pin projecting into the area of the bright pinhole.[9]

All of these phenomena show that if a retinal receptor is stimulated, no matter how, the corresponding percept will have a direction, relative to the eyeball, *as if* it were being "projected" outward roughly along a produced radius of the retinal sphere.

With their attention upon the retinal image of a present object, however, most writers have proceeded to forget these entoptic phenomena and have discussed the law of direction in terms of "lines of direction" dictated by the actual light-rays forming the image. Thus, Sir David Brewster (whose *Treatise on Optics* was first published around 1831) was at pains to point out that the various rays which enter the pupil to form a retinal image-point approach the retina from *various* directions. He solemnly proved experimentally that when light was admitted through only a part of the pupil—any part—the apparent direction of the object did not change. The "line of direction" from a retinal point, which determined the direction in which the object-point would be "projected" and seen, must then not be the direction of any one incoming ray but a resultant of all. This resultant is a mathematical concept but not an optical reality. As near as Brewster could tell, the direction-line was a perpendicular to the retina at the point stimulated. Others before him had thought this, but still others had doubted it; and it had also been simply said that the direction-line was a straight line joining the image-point and the object-point! Brewster determined graphically that this line and the perpendicular, anywhere in the fundus, would not differ in direction by more than an imperceptible one-half degree. He went on anyway, to explain erect vision by pointing out that the lines of direction (however defined) cross within the eye at the "center of visible direction"—at what we, nowadays, would call

[9]An experiment commonly credited to Czermak (1851), but described as early as 1772 (by Joseph Priestley).

the perspective center of the eye. And in his later editions, Brewster took occasion to lambaste the persistent idea that "all infants see upside down, and it is only by comparing the erroneous information acquired by vision with the accurate information acquired by touch, that the young learn to see objects in an erect position!"

Skipping a few decades, we find the tradition continuing among optical writers. Looking in upon Aubert, writing his *Physiologischen Optik* (1876), we find him saying that projection must be *native*, since "unfamiliar sensations" (phosphenes, vessel-shadows, retinal blood-corpuscles, after-images) are projected in the same manner as retinal images. Aubert's "lines of direction" connected retinal points with object-points through the posterior nodal point. This is pure coincidence, if direction-lines are *not* the directions of light-rays, but Aubert did not make this clear for his readers.

Sampling the "objective," eyeball-minded literature of the erect-vision problem again, a couple of decades beyond Aubert, we find Joseph LeConte invoking the law of direction to correct the "erroneous" ideas of the psychologists (LeConte, 1895), and explaining the laws of projection and direction at even greater length in the second edition of his excellent *Sight* (1897) than he had in the first (1881): The retinal image forms a retinal impression, which is conveyed to the brain and then projected into space as a facsimile of the real object. The projection of each image-point is back along the ray-line of the "central ray" of the conical pencil of incoming rays; so, all direction-lines cross at the nodal point and erect vision is accounted for. LeConte, of course, had no patience with the "metaphysical theory" that if all things are inverted, nothing is inverted. For him, erect projection of an inverted image, while "acquired" in "ancestral experience," was inherited and *native* for the present human individual: "Every rod and cone has its own correspondent in space." This is essentially the idea of retinal local sign (although LeConte gives no evidence of having ever heard of that expression). Moreover, "the perpendicular direction of the rods and cones to the retinal concave is probably related to the direction of impressions into space . . ." An infant turns its eyes towards a light, and "therefore" must see the light in its true position!, etc.

Hyslop—though a good psychologist—haggled with LeConte in correspondence, regarding the proper conception of the lines of direction. Hyslop insisted that they are perpendiculars to the retinal surface (and entirely native), and this conviction led him to propose (1897b) that if the retina were convex (everything else remaining the same), we would see objects as inverted. LeConte finally—though not publicly—

agreed to this, as is shown by his marginal notes in a reprint of Hyslop's paper, which I have been privileged to examine. Neither man noticed (although LeConte should have) that in the development of a rapidly progressive myopia the individual should be aware of a tremendous and increasing *macropsia*—if direction-lines are "perpendiculars" (and if I may be pardoned for injecting a little eyeball optometry here). And, of course, no one has ever shown why a perpendicular should have such magic.[10]

While we can and should discard the "law of projection," we can do so and still salvage the "law of visible direction" *if* we find that it *works*, in any of its forms of expression. And, it *does* work when it is properly translated into a law of oculocentric directionalization, cortically mediated *(vide infra)*. But, as an *eyeball* law[11] or as a retinal law, it begs the question of erect vision and explains neither this nor anything else. We have no sort of "awareness," even at a physiological level, of the directions of approach of light-rays, or of perpendiculars to the retina. If the direction in which an object-point is seen is "tied" to the retinal point on which its image falls (and this is what the local sign doctrine says), erect vision with an inverted image is not *explained* by such a law of direction unless the law is assumed—i.e., unless the "tie" is innate. Whether *this* is true or not is a separate and decidedly prior question. If the innateness cannot be proved, then the "law of direction" could only be implemented by invoking "experience," whereupon it will always be found that the "law" becomes an empiricistic eye-movement theory of visual localization, and we are back to George Berkeley. All this was clearly perceived by Johannes Müller, as early as 1826, when he said that to appeal to such things as the directions of impinging light-rays (to account for erect vision with an inverted image) is to consider that seeing is explained by seeing.

Now, it may seem that this discussion of the law of direction is pertinent only to our original problem, which wiser heads than mine insist is no problem at all—"why is it that we see things right-side-up, when their images on the retina are inverted?" But the matter in this section does have an immediate bearing upon our second question—"is the optical inversion of the retinal image essential for the visual perception of objects as right-side-up with respect to the self?" For, if the

[10]On the other hand, we *do* know, nowadays, of a differential sensory effect that depends upon the direction from which a ray of light enters a retinal cone. But this—the Stiles-Crawford effect—has no "spatial" consequences.

[11]The great Wundt started *his* lines of direction not from the retina, but from the center of rotation of the eyeball (see Wundt, 1902). On the other hand Wundt's worshipper, Titchener, took them from the object through the nodal point to the retina (Titchener, 1906, p. 131).

ego-anchored direction of an object-point is *natively* tied to the stimulation of a particular retinal point, the answer to the new question must be "yes" unless one wishes to propose that a relationship based upon a built-in arrangement can be completely undone and reconstructed otherwise, by "experience." And, if the ties between retinal points and perceived directions of perception are not innate and "given" at birth, then the answer to our new question must be "no," and one must suppose that if correct visual localization has to be learned in the first place, it can surely be relearned if the merely optical situation is changed—in an experiment, or in ocular pathology in the broadest sense of the term.

"RETINAL LOCAL SIGN"

It was strongly hinted above that retinal local sign is a pretty direct descendant of the law of visible direction. That is true conceptually—but not historically; for, the doctrine of local sign originated in connection with tactual-kinaesthetic space-perception, and was carried over to the retina and visual space-perception secondarily.

Before 1852, R. H. Lotze had had demonstrated to him Weber's "sensory circles" in the skin, and had been intrigued by the phenomenon of single, then dumbbell-shaped, then double perception of a pair of compass-points as these are pressed repeatedly against the skin with increasing separation. In his epoch-marking *Medicinische Psychologie* (1852) and in later publications, Lotze developed very fully his conception of "Localzeichen" as pertaining to dermal and kinaesthetic sensations, and less fully the conception as relating to vision and the retina:

Lotze assumed, and thought he could prove, that tactual-kinaesthetic localization was entirely learned. "A newborn child does not at first sense a pressure on the face as being elsewhere from a pressure on the leg" (p. 396). The two experiences are qualitatively different, but the difference is not perceived as spatial. The baby has to *learn* the meaning of each quality of sensation as connoting a spatial localization on its body. The difference in sensation given by two spoken vowels is due to a difference between stimuli, whereas the *same* stimulus applied to the cheek and to the leg gives two sensations differing in another way, and the mind can make use of these differences. Similarly when the baby reaches here, or there, each movement feels different, though initially the difference does not *mean* difference of location of the thing reached. Another time, when touching the same place brings the same kinaesthetic sensations, these latter *mean* the same place.

If, now, a sense-organ can be so carried or oriented, by a muscular system, that each sensitive point can be given a unique "aim" in space,

and if furthermore a fixed stimulus affects a different receptor for each of these muscularly-sensed directions of aim of the organ, then each receptor and the act of its stimulation have a "completely mathematical" relationship, and the stimulation of the receptor-element constitutes an exclusive, unique, *local sign* belonging to that element. This is the gist of what Lotze said on the page (p. 333) on which he introduced the expression "Localzeichen." Specifically, if a retinal receptor somewhere in the periphery is stimulated, the muscular activity required to fixate the stimulus educates the mind as regards what place in space the stimulus must have occupied, and thereafter a stimulation of that receptor connotes "place" because it sets off a *tendency* for the fixative movement to occur. But always and forever, and not only initially, the receptor must be able in *some* way to inform consciousness that: "*I* am the receptor being stimulated thus and so, and not any other receptor." And it is *this* property of the receptor which is its "local sign."

It does not matter any more, now, just exactly what the physiological property was, capable of 7,000,000 differences, that Lotze conceived to be the basis of the local signs of the cones of a human retina. Lotze spent many pages in a discussion of visual localization, with his attention closely upon the old problem of erect vision despite an inverted image. In this whole discussion he never once uses his own term, "Localzeichen," which is perhaps why all textbook writers since, who perhaps only sampled Lotze's book (or each other's) have said that Lotze confined his local-sign concept to the skin, or at most to the tactual-kinaesthetic realm of space. *Hering*, in the textbooks, is given credit for transferring the local-sign idea to the retina. And, inasmuch as Hering was emphatic in his assumption that the local signs of retinal receptors *innately* connote spatiality, the belief is general that *Lotze* considered the unique spatial connotations of the stimulations of unique receptors to be *given*, at or before birth. Nothing is farther from the truth. Lotze, like any other important writer in our general field of science, deserves to be read, by everyone, in the original and in full. But since it is hopeless to try to wean busy people away from reliance upon textbooks (those broken reeds!), I shall abstract, here, Lotze's argument relative to vision. At *this* point in his book (pp. 360-371) Lotze was assuming that his reader had "local signs" under his belt, and *that* is why they are not mentioned by name. So then, Lotze speaking —paraphrased into modern words, of course:

The location of a receptor in the retina is a motive for the mind to locate in a corresponding place in the visual field, the impression received

by way of that receptor. Must this influence of the retinal points upon perceived spatiality be explained on the basis of developed relationships to strengths of eye-movements in particular directions, which in themselves no longer get into consciousness? Is it not simpler to hold that it lies in the nature of the excited receptor, for its excitation to have a unique qualitative aspect such that the mind directly (i.e., natively) localizes the source of excitation? No, there is no physiological possibility of such a specific quality of impression from each and every receptor.

Related to this question of the relative positions of points in the visual field is the problem of the inverse position of the field as a whole relative to the retinal image. Why do we not see objects inverted? Some say that we do see everything inverted, but therefore never notice the inversion of the whole. But we can look through a telescope and if its image is inverted we know it, even if we see no background with which to contrast the inverted orientation of the telescope image. This inversion we appreciate through its contradiction of spatial representation *via* other senses. Some will object that if we had always gotten our retinal images through the telescope it would go quite unnoticed whether their orientation agreed or disagreed with that of the object—or, if the object were something unknown, we could get no information from it as regards the position of the retinal image (which is true, but is not pertinent). We *can* perceive the difference between two orientations of the same picture when it fills the field and there is no background to compare it with. How could this be unless we are obtaining *essentially different* impressions? If the retinal image is rotated 180° the retina is continuously, differently stimulated and the shifting of stimulation is evident in consciousness. Only subsequently can there be any comparison with non-visual spatiality. So, it is certain that we do see everything erect, contrary to the retinal image.

Attempted explanations have included the claim that the retinal image, traveling in some form up the optic nerve, rotates 180° and thus comes upright before the astonished mind's eye. It would be cleverer to claim that the image sails into the brain without rotation, and that the soul is upside down and therefore sees objects upright! Not much better is the assumption that the mind recognizes the direction of light-rays striking the retina, which, because they cross, give crossed perceptual directions of external points. Worse yet is the idea of projection perpendicular to the retina—as well say that anger stands perpendicular to insult, or that price is perpendicular to worth.

Such "theories" err by discussing erectness without defining it first. If we had *only* visual impressions, the words up, down, left, right, etc.,

could have no meanings. The visual field would be circular, but with no position either upright or inverted—lacking anything else in consciousness to compare it with. One cannot ascribe erectness, inverseness, or slantwise orientation to the Universe. Ascription of visual position can derive only from having each field-point take its special place in a tactual-kinaesthetic space-image. "Upper," in the visual field, is what appears nearer the head and could be reached by a tactile member on the head; "lower" is what appears nearer the feet and could be reached by lower tactile members. *After* learning the variable posture of the body, we can give independent meaning to visual "up" and "down" by reducing our posture to an erect-bodily-position situation.

All of the foregoing (Lotze says) is no more than a definition of what it is that has to be explained. There is a common prejudice that the inverseness of the retinal image is itself a motive for the mind to see things inverted—the image must become "psychically" re-inverted because its position has meaning for the mind and is somehow a hindrance to erect seeing, which the mind must overcome by a special exertion. Nonsense—the mind does not inspect the position of each retinal receptor, *but* that position operates upon the mind, and is the motive for the mind to localize stimulation of that receptor just "thus" and not "so." The inversion of the image has no more weight for the mind than the locations of a bunch of points in a closed box. The spatially-distributed retinal image is translated physiologically into a collection of excitation-states, and intensities thereof, which have no *positional* relativity to each other or to anything in the outside world. The orientation of the retinal image may be what it will—there is no primal *necessity* for the orientation of the perceptual image to agree with it. No, orientation of the image must *operate*, and in such a way that the stimulation of a "down" retinal point has an effect which creates the possibility of *associating*, with that effect, a spatial point which—in tactual-kinaesthetic space—is *up*.

Now (Lotze goes on), in the making, *per se*, of such associations, Nature has a completely free hand. Sensory fibers have to be brought into functional relationship with motor fibers, but it is all the same to "Nature" whether an upper, a lower, or a leftward retinal point is to be put thus in touch with particular motor fibers. One arrangement is as easy to make as another; so, to account for what we do know to be the case, a special mechanical explanation is required. Nature's degrees of freedom are at once restricted by the *ends* she must seek to attain through sensory-motor organizations. There has to be harmony between visual localization and tactual localization, and this makes a twofold demand: (1) Each peripheral point in the visual field must arouse,

or arouse a tendency to, the making of a searching movement of the eye, like the movement of a tactile member which, anchored where the eye is, would try to reach the same object-point. (2) This turning of the eye must be one that would accomplish something valuable—to be specific; the bringing of the image of the object-point onto the retinal locus of most distinct vision.[12]

These requirements can be met only by one of two arrangements—an erect image on a convex anterior ocular receptive surface, or an inverted image on a concave posterior eyeground. In the vertebrates, where the small pupil requires the employed light-rays to cross, and the center of rotation of the eye lies between the sensed image and the object, the second arrangement occurs. If the retinal image, in our case, were *not* inverse with respect to the real object, senseless contradictions would occur—e.g., we would have to turn the visual axis downward to bring an "up" object onto the fovea. This movement would contradict the spatial pattern established by taction-and-kinaesthesia, and it would defeat the ends of vision itself since the averted pupil would admit less light from the object. Such an eye would "work" only if the whole head took over all aiming movements, so that the center of rotation lay behind the image (as it does in, say, a lobster).

So, Lotze concludes, the orientation of the image on the retina is *per se* entirely indifferent for the orientation of the visual field we perceive; but, if this latter is to jibe with haptic space-perception, *our* ocular morphology makes the inversion of the retinal image not a "hindrance" *but an absolute necessity*. Now this may seem to explain only how the orientation and the position of the varying field-contents of a *moving* eye are brought into harmony with haptic space-locations. With a motionless eye and a fixed field, we still see up points up and left points leftward, etc., despite the inverted-and-reverted image. Even a congenitally-blind, given vision surgically, sees thus also; for him, visual objects are in directions no different from what they are for those who have always seen.[13] We cannot therefore say that initially the visual field is devoid of all orientation exterior to ourselves, and that secondarily the feeling of an actual eye-movement, or a merely contemplated movement, as a datum, is offered for the mind to mull over, and that from this the various parts of the visual field get their perceived positions. "Each association of a retinal point with a movement-tendency is only

[12]Lotze is very plainly saying, here, simply that it is the requirements of a fixation reflex that dictate the connections each visual fiber must establish within the brain. Without discussing them, he is explaining the requirements of a tracking ("following") reflex even better, if possible.

[13]Lotze never does clarify *this* statement, which appears to say that visual local signs are inborn and absolute, not acquired nor merely relative!

a principle-of-conduct for an unconscious and involuntary activity of the mind." The impression this association makes on the mind does not generally rise into consciousness—or if at first it does, it later ceases to be noticed after the eye has become educated and has had long practice on its functions.

Thus, Lotze is saying, all awareness of movement-tendencies fades away ontogenetically, and permanent localizability of visual stimuli remains for the eye without the least consideration of eye-movements, although it could not have been established, originally, *without* eye-movement. As if anticipating the perversion his purely empiricistic doctrine was shortly to undergo in the hands of Panum and Hering, Lotze ended the discussion by saying: "So it comes about that the orientation of the perceptual image *seems*, to us, to be something simply *given*" (i.e., native).

Now, if the reader has followed closely, he must have been struck by a great similarity between Lotze's whole corpus of ideas and Berkeley's. Lotze, in his book at least, acknowledged no debt to Berkeley, and indeed gives no indication of having ever heard of Berkeley. But they thought largely alike. Both men demolished the law of direction as an eyeball law. Both thought of visual localization as having to agree with tactual-kinaesthetic localization and body-image, both thought the visual had to be educated by the tactual—but both thought the tactual itself to be acquired and not innate. Both considered eye-movements to be an indispensable basis for the acquisition of visual localization. Lotze half-conceded Berkleian "relativity."

Lotze parted from his unseen companion, however, by coming to the conclusion that an inverted retinal image is mandatory if the object is to be perceived as erect. The "retinal local sign" conception, though, was not in itself responsible for this. Lotze was just as much an empiricist as Berkeley, and so the spatial significance of local sign had to be empirical.

The local-sign idea is quite immune to attack; for, it can be all things to all men. In Lotze's hands (and later in Helmholtz's and von Kries') it served to bring Berkeley's quaintly-expressed tenets closer to physiological implementation in modern terms. Lotze flatly rejected any possible built-in (anatomical) implementation of local sign. But a nativist, following Lotze, did not have to reject local sign. Instead, he needed only to assume—and he eagerly did so—that the spatial connotation of each local sign was a "given." Indeed, one may say that the greatest value the local sign concept has had, in the history of visual physiological-psychology, is that it afforded just this opportunity

to assume its spatial nativeness. For this enabled the nativistic view of visual spatial localization to survive—through Hering and Hoffmann—until the physiological neuroanatomists of the present century could discover a concrete basis for it.

Even when the *Medicinische Psychologie* was fresh from the bindery, Lotze could have been attacked more vigorously than he ever was. It is really surprising that more of his important contemporaries were not highly skeptical of a proposal that 7,000,000 cones could have 7,000,000 individual physiological differences of some one kind—and the *kind* undefined at that! The idea is more readily acceptable now than it should have been then. So many receptors could not differ individually in any way except by *being* different individuals. They do not need to be "no two alike;" they need only to be unitary and to be in different positions in the retina—and the nativeness of *these* features could not be more obvious. The specificity of each receptor that confers "local sign" is simply the unique chain of connection it makes through bipolar cell, ganglion cell, optic nerve-and-tract fiber, and geniculocalcarine fiber, to sharply localized representation among the ganglion cells of the primary visuo-sensory cortex, "Area 17." Even television has not been possible without an actual or constructive mosaic of separate receptors. A homogeneous or practically grainless receptive surface like that of a barrier-layer cell or a Lipmann plate could not work at all for either television or vision. The visual cells are not discrete entities merely because they are cells. Biologically, they could as well form a syncitium (as the Müller fibers of the retina probably do). But vision could then have no spatial properties. At the most, the blank integral of the retinal illumination, that we would perceive, might be localizable as coming in front of us rather than from elsewhere.

No, there was no loud questioning of the distinctness of the local signs of the receptors. There were not even any serious attempts to crack the code of the signals that were supposed to be convertible into spatial connotations through association with eye-movements. But Lotze's empiricism regarding the conversion was vulnerable. Lotze, according to his own lights, should have thought that we do *not* have to have an inverted retinal image of an object or a whole eye-field, to see it erect. Nor would any imaginable permanent optical distortion of the image (so long as it was sharply focused) be of the slightest consequence. And *every* squinter with diplopia should be able quickly to develop ideal ("harmonious") anomalous correspondence and regain haplopia. Worst of all, Lotze would have had to say that if an infant's extra-ocular muscles should all be cut, "up" and "down" and "left," etc., could never have

any meaning for him within his visual field and within his visual perceptual modality. Who would believe this?

The fate of Lotze's retinal local sign doctrine was that it became the rope in a tug-of-war in which neither side *could* win until the present century. It was adopted, just as Lotze left it, by Helmholtz when he was writing the first edition (1856-1866) of the *Handbuch der physiologischen Optik*. One may still easily read Helmholtz's own completely empiricistic treatment of monocular space-perception on pp. 154-232 and 242-270 of Volume III of Southall's English translation of the final (third) edition (Helmholtz, 1925), and von Kries' additions to it and defense of it on pages 232-242, 607-625, and 635-652. A great deal of literature by others is, of course, covered in those places, discussion of which is omitted in this brief review. Essentially, Helmholtz's theory, even as voiced by its most modern adherents, is nothing but the hoary eye-movement theory of visual localization, inasmuch as it depends upon local sign spatiality that has to be *learned*.[14]

The leader of the opposite team was Ewald Hering. Panum (1859-1861) was the first to borrow Lotze's local signs and assume their visual spatial significances to be innate. But Hering, with some help from Stumpf (1873), carried this flag from 1861 until his death. Hering unnecessarily complicated the issue at first, however, and brought local signs (and the possibility of their nativeness along with them) into ill repute by his preposterous proposal that each receptor is endowed with *three* local signs at once. Hering never seemed to be able to think of an egocentric spatial location as being compounded simply of a direction and a distance. He thought rather in terms of imaginary coördinates, and had to have one local sign for the horizontal separation of the receptor from the retinal center and another for the vertical separation. To this needless and physiologically unacceptable resolution of direction into two components, Hering added a third local sign for *depth*, and clung to this for years after his closest scientific friends had discarded it—which they did almost at once. It may be said, in passing, that practically all discussions of the problems of visual direction are greatly confused by allowing "depth" a place in them. We here, for example, are not considering the given-ness or learnedness of "three-dimensional space," but only of *direction*.

With the question of the spatiality of retinal local signs, as with so many other matters, nativism had to remain "a faith and not a

[14]Incidentally, it needs pointing out that the mad and favorite idea of so many teachers of elementary psychology, that an infant at first sees upside-down, assumes local sign *and complete innateness thereof*. How, else, is the infant to see things upside-down instead of with-no-orientation-at-all?

theory" unless and until some overwhelming evidence for it appeared. Such evidence, as a by-product of modern neuroanatomical research, and crisply confirmed by neurophysiological research, has accumulated in recent years to a degree that should completely convince anyone who learns of it.[15] Anatomical isomorphism between the retina (and its image) and the visual cortex (and *its* image) is known to exist and known to be so precise as to account for all the facts that need accounting for.[16] Hering had to *assume* such a situation, and Helmholtz had to assume that there was no such situation. Neither of them *knew* anything more about it than Johannes Müller—or René Descartes—had known. Both were in their graves before the basis of the nativeness of "retinal local sign" was worked out so that we of the twentieth century could discard the term and begin to talk of "cortical directional sign" instead.

The neurological evidence for the nativeness of cortical directional sign will be presented in the second paper of this series, which will appear in the March issue of *American Journal of Optometry*.

[15] *Not* valid evidence for nativeness, however, is Duke-Elder's evolutionary derivation of visual local sign from tactual local sign (Duke-Elder, 1946, p. 1061). The visual cells never had any dermal cell-ancestors which were receptors of any kind (see Walls, 1939).

[16] At any time, after general agreement was reached that the retina is actually an ectopic portion of the brain wall and homologous with the cerebral cortex and more too, it might have been suggested that the retina itself may "know" where it is being stimulated. So far as I know, *this* conception of local sign has never been offered—and I would not seriously advance it here.

BIBLIOGRAPHY

Aubert, H. (1876)
Physiologischen Optik. In: Graefe-Saemisch, *Handb. d. ges. Augenheilk.*, Ed. 1, Bd. II, Theil 2, Cap. IX. Leipzig: Wilhelm Engelmann.

Berkeley, G. (1709)
An Essay Towards a New Theory of Vision. (As published in: "A New Theory of Vision and Other Select Philosophical Writings of George Berkeley Bishop of Cloyne." = No. 483 of *Everyman's Library*, 1929 reprint: New York: E. P. Dutton and Co., Inc.)

Boring, E. G. (1942)
Sensation and Perception in the History of Experimental Psychology. New York: D. Appleton-Century Co., Inc.

Brewster, D. (1853)
A Treatise on Optics. London: Longman, Brown, Green, and Longmans.

Duke-Elder, W. S. (1946)
Text-book of Ophthalmology: Vol. I. St. Louis: C. V. Mosby Company.

Ewert, P. H. (1930)
A Study of the Effect of Inverted Retinal Stimulation Upon Spatially Coordinated Behavior. Genet. Psych. Monog., 7, 177-363.

v. Helmholtz, H. (1925)
Helmholtz's Treatise on Physiological Optics, translated from the third German edition: Vol. III. (Edited by J. P. C. Southall.) New York: Optical Society of America.

Hyslop, J. H. (1897a)
Upright Vision. Psych. Rev., 4, 71-73.

———— (1897b)

Upright Vision. Psych. Rev., 4, 142-163.

Le Conte, J. (1881)
Sight: An Exposition of the Principles of Monocular and Binocular Vision. New York: D. Appleton and Company.

———— (1895)
Erect Vision and Single Vision. Science 2, 629-630.

———— (1897)
Sight. 2nd Ed. New York: D. Appleton and Company.

Lotze, R. H. (1852)
Medicinische Psychologie oder Physiologie der Seele. Leipzig: Weidmann'sche Buchhandlung.

Maurolico, F. (1940)
The *Photismi de Lumine* of Maurolycus. A chapter in late medieval optics. (Transl., H. Crew, from 1911 Naples ed.) New York: The Macmillan Company.

Molyneux, W. (1692)
Dioptrica nova. A treatise of dioptricks, in two parts. London: B. Tooke.

Müller, J. (1826)
Zur Vergleichenden Physiologie des Gesichtssinnes des Menschen und der Thiere. Leipzig: C. Cnobloch.

———— (1835-1840)
Handbuch der Physiologie des Menschen für Vorlesungen. Coblentz: J. Holscher.

Polyak, S. (1941)
The Retina. Chicago: University of Chicago Press.

———— (1943)
The History of Our Knowledge of the Structure and Functioning of the Eye. (= Historical Appendix to *The Human Eye in Anatomical Transparencies.*) Rochester, N. Y.: Bausch and Lomb Press.

Postman, L. and Egan, J. P. (1949)
Experimental Psychology: An Introduction. New York: Harper and Bros.

Southall, J. P. C. (1937)
Introduction to Physiological Optics. New York: Oxford University Press.

Titchener, E. B. (1906)
Experimental Psychology. Vol. I, Part I. New York: The Macmillan Company.

da Vinci, Leonardo (1584)
Trattato della pittura. In: Richter, J. P. and Richter, I. A., 1939, *The Literary Works of Leonardo da Vinci;* 2nd Ed., Vol. 1: New York: Oxford University Press.

Walls, G. L. (1939)
Origin of the Vertebrate Eye. Arch. of Ophth., 22, 452-486.

Wundt, W. (1902)
Principles of Physiological Psychology (translated from the 5th German edition): Vol. 1 (1904). New York: The Macmillan Company.

Zoethout, W. D. (1947)
Physiological Optics. 4th Ed. Chicago: Professional Press, Inc.

ABSTRACTS

TRIFOCALS. Eugene Bedell. Today's Health (formerly Hygeia). 28 (11), 18-19, 44. Nov. 1950.

The author presents some interesting points on trifocal lenses that she garnered from interviewing several ophthalmologists. Examples of the usefulness of trifocals are cleverly dramatized in the case of a Canasta-player, a housewife, a lawyer, and a butcher.

A brief question-and-answer account explains: what are three-way lenses: why bifocals are often inadequate: the importance of the middle or working range; ease of adjustment to trifocals; and the indications for the need of three-way lenses.

It is well for optometrists to be familiar with this report since their patients may refer to it especially, since the article ends by quoting a leading ophthalmologist as saying: "The 45,000,000 Americans over 40 years who wear glasses should discuss three-way lenses with their eye doctors, since most are potential users."

R. E. B.

COMPENSATORY CYCLO-TORSION AND VISUAL ACUITY*

William G. Walton, Jr.†
Pennsylvania State College of Optometry
Philadelphia, Pennsylvania

In a previous investigation it was shown that tilting the head toward the shoulder results in a compensatory cyclo-torsion of the eyeball of one-third the amount of the head tilt.[1] Thus tilting the head 30 degrees toward the shoulder results in a 10 degree compensatory turning of the eyeball toward its normal position. This means that a person wearing a correction containing a cylinder, would in the tilted position no longer have the meridian of least refractive power of the eye coincident with the axis meridian of the ophthalmic lens. A cylindrical correction with the axis not in the proper meridian results in a reduction in visual acuity. The question then arises as to what is the effect on visual acuity in the case of a head tilt while wearing a cylindrical correction.

This investigation is to determine the effect on visual acuity by (a) tilting the head 30 degrees toward the shoulder; (b) turning the cylindrical axis 10 degrees from its proper position.

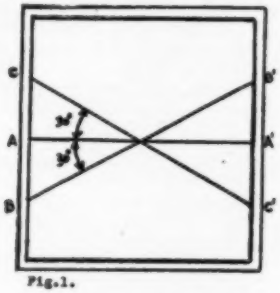


Fig.1.

The following equipment was used in this investigation: an Ives visual acuity meter, a trial frame and test case lenses, an occluder, and a specially constructed framework (Figure 1) to measure a 30 degree head tilt as well as the straight head position.

Twenty-five subjects whose cylindrical correction was at least 1.00

*Read before the annual meeting of the American Academy of Optometry, Chicago, Illinois, December 17, 1950. For publication in the February, 1951, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

†Optometrist. Member of faculty. Fellow, American Academy of Optometry.

[1]Compensatory Cyclo-Torsion Accompanying Head Tilt. Am. J. of Optom. and Arch. of Am. Acad. Optom. 25. 525-534. 1948.

diopter in amount were selected. Each subject was tested three times as follows:

Test 1. A trial frame was placed on the face of the patient with the proper correction in place. The eye not being tested was occluded. The subject was so placed before the framework that the canthi were in line with thread AA′. An Ives visual acuity meter was placed before the subject at a distance of 3 meters. The visual acuity rating was determined by averaging a series of readings. The grid squares were made too small to be seen and then enlarged until the subject reported just being able to distinguish the grid as such. Then the grid squares were made definitely visible and reduced in size until the subject reported the grid no longer distinguishable as such. Several readings of each type were taken and averaged to give the visual acuity rating for the subject under normal conditions.

Test 2. The head of the subject was tilted 30 degrees toward the right shoulder and the canthi aligned with thread CC′. Then the head was tilted 30 degrees toward the left shoulder and the canthi aligned with thread BB′. Readings in both positions were taken as for Test 1. These two sets of readings were averaged to give the visual acuity rating with a 30 degree head tilt.

Test 3. The head of the subject was placed so that the canthi were again aligned with thread AA′. The cylindrical axis was rotated 10 degrees from the proper position in one direction, then 10 degrees from the proper position in the opposite direction. Readings for the two positions were taken as in Test 1, and averaged to give the visual acuity rating with a 10 degree off axis cylinder.

Table 1 shows the results of this investigation. The horizontal columns are for the 25 subjects used. The vertical columns are, in order from left to right: Column 1, correction; Column 2, percentage visual acuity for Test 1; Column 3, percentage visual acuity for Test 2; Column 4, percentage visual acuity for Test 3; Column 5, the percentage difference between results for Tests 1 and 2; Column 6, the percentage difference between results for Tests 1 and 3; and Column 7, the percentage difference between results for Tests 2 and 3.

In each case we note a reduction in visual acuity when the head is tilted toward the shoulder. A still greater reduction in visual acuity is noted when the cylinder is turned 10 degrees from the proper axis position.

It seems apparent from these results that tilting the head toward the shoulder while wearing a cylindrical correction causes some compensatory action in our interpretation of what we see so that we do not have as

great a loss in visual acuity as we do when a cylinder is not at the proper axis position. Just how this compensation is brought about we are not able to say at this time.

TABLE 1

SUBJ.	1 CORRECTION	2 % TEST 1	—3— % TEST 2	4 % TEST 3	5 % DIF. TESTS 1 & 2	6 % DIF. TESTS 1 & 3	7 % DIF. TESTS 2 & 3
1—	+2.75—1.00x180	1.00	.83	.775	17.00	22.50	5.50
2—	+3.00—1.25x165	.97	.80	.7275	17.53	25.00	7.47
3—	+1.00—1.50x180	.68	.6225	.57	8.46	16.18	7.72
4—	+1.25—2.75x180	.68	.635	.595	6.62	12.50	5.88
5—	—0.50—1.00x180	.785	.7125	.6925	9.24	11.79	2.55
6—	+5.75—1.75x180	.40	.3025	.2425	24.38	39.38	15.00
7—	+5.75—1.75x180	.39	.30	.24	23.08	38.47	15.39
8—	+3.00—1.50x180	.795	.655	.5875	17.61	26.11	8.50
9—	+2.50—1.25x180	.765	.695	.655	9.16	14.28	5.22
10—	+5.00—2.50x12.5	.49	.4125	.385	15.82	21.43	5.61
11—	+0.50—1.75x30	.70	.605	.525	13.58	25.00	11.42
12—	+1.50—1.00x180	.47	.40	.355	14.90	24.47	9.57
13—	—1.50x15	.475	.38	.31	20.00	34.74	14.74
14—	—1.25x145	.423	.40	.375	5.44	11.35	5.91
15—	+0.25—1.25x5	.485	.44	.4325	9.28	10.83	1.55
16—	—0.25—1.25x20	.55	.475	.465	13.64	15.46	1.82
17—	—0.25—1.50x180	.897	.6775	.63	24.48	29.77	5.29
18—	+0.50—1.00x180	.52	.44	.425	15.39	18.27	2.88
19—	+0.50—1.00x15	.805	.745	.66	7.46	18.02	10.56
20—	+0.75—1.50x180	.87	.8375	.7625	3.74	12.36	8.62
21—	—2.00—1.00x10	.875	.80	.72	8.59	17.72	9.13
22—	—2.25—1.25x95	.725	.675	.62	6.90	14.49	7.59
23—	—2.25—1.25x75	.70	.615	.50	12.15	28.58	16.43
24—	—0.25—1.00x180	.76	.615	.585	19.08	23.03	3.95
25—	—0.25—1.00x180	.65	.505	.4725	22.31	27.31	5.00

ABSTRACTS

RANGES OF CLEAR VISION THROUGH MULTIFOCAL LENSES. V. J. Ellerbrock and K. S. Zinnecker. Optometric Weekly. Vol. XLI. No. 51. 1893-1900. Dec. 21. 1950.

The authors introduce an improved graphical method to illustrate the limits and ranges of clear and comfortable vision through multifocal lenses.

A survey of the literature is presented showing the various criteria employed to determine the power of the near add in presbyopia. These criteria vary, according to different authorities, in the need for keeping a certain amplitude of accommodation in reserve. Some claim that no amplitude should be kept in reserve while others recommend that 1/5, ¼, ⅓, ½ or ⅔ should be kept in reserve. A number of graphs are presented which illustrate the pertinent data resulting from the use of the various criteria.

On the basis of all the factors considered by the authors, they conclude that "the trifocal lens appears to be indicated whenever the near addition is 1.25 D. or more."

R. E. B.

THE EFFECT OF BASE-OUT PRISMS ON EYE-HAND COORDINATION*

Neal J. Bailey†
School of Optometry, The Ohio State University
Columbus, Ohio

Just a few minutes reflection is sufficient to convince one that an object seen is really not an object at all but an image projected into space. This image is an interpretation of impressions received at the cortex from the retinae. If questioned as to where this object lies, the subject may indicate its perceived direction by pointing toward the perceived image of the object with his hand. Should the observer actually point toward the physical object itself, the subject is described as having good visual projection and good eye-hand coordination.

In connection with the investigation of projection in persons with anomalous correspondence, the question arises as to whether there might exist a neurological relationship between either eye and the homolateral hand in which the right hand points in the direction the right eye is pointing, and similarly for the left hand and left eye, regardless of which is used for fixation. Such a connection, if it existed, would make the investigation of projection, by the hand-pointing method, very difficult, since the direction of pointing could then vary not only with the eye used, but also with the hand used to demonstrate where in space the perceived image is in relation to the observer.

The question also arises whether a similar neurological arrangement exists in subjects with normal correspondence. If it does exist, it should be demonstrable in normal individuals by placing base-out prisms before the two eyes. With the base-out prisms, the eyes turn in to compensate for the prisms, with the right eye pointing to the left of the object and the left eye to the right of the object. If a close relationship existed between either eye and the homolateral hand, one might expect the subject to point to the left of the object when using the right hand and to the right of the object when using the left hand. (Figure 1.)

When equal base-out prisms are placed before a normal individual's eyes and the subject is directed to walk toward an object (a procedure which eliminates all effects of bilaterality), he is able to walk toward the object in just as straight a line as without the prisms. This solves the

*Submitted on December 21, 1950, for publication in the February, 1951, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.
†Research Fellow, American Optometric Foundation.

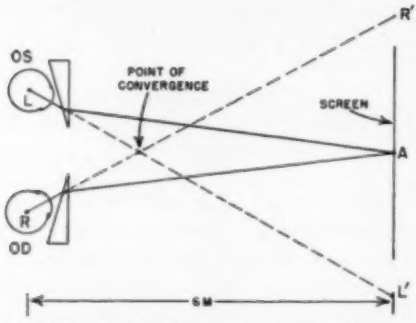


Fig. 1. If a neurological relationship between an eye and the homolateral hand were present, with the right hand the observer would tend to shoot parallel to line RR^1. With 25Δ of base-out prism, the separation of R^1 and L^1 would be about 14 degrees and hence, in shooting at target A, a miss of about minus 7 degrees would be expected.

problem of the direction in which the subject projects the images formed on the foveas of the two eyes. It remains then to determine in which direction the subject points, to decide whether the change in the position of the eye will affect the direction of pointing with the homolateral hand or whether the process of pointing at a visually perceived image is a matter of coordinating kinesthetic space with visual space.

An optical pointer was mounted on a pistol handle and equipped with a trigger for turning on the light in "shooting" at the target. In order that visual clues as to the hand or arm position could not be used to help direct the pointer toward the target, a rectangular board, 4 by 5 feet, was placed parallel to the floor. The subject's chin rested well over the edge of the board and the subject (Figure 2) could see no part of his own hands or arms.

The target (Figure 3), consisted of a central cross with 10 vertical lines of 1 degree separation on either side of it. A projector was used to project the target on a screen 6 meters directly in front of the observer.

Ten students with normal binocular vision served as subjects; none of them knew the purpose of the experiment. The ability of each

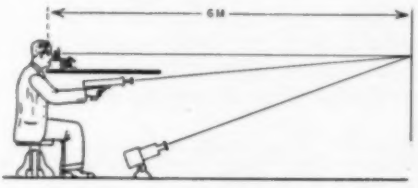


Fig. 2. Arrangement of equipment used in the experiment.

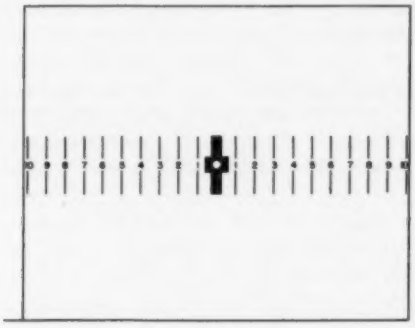


Fig. 3. Target.

student to fuse base-out prism was checked first, a minimum of 25Δ being necessary to qualify for the experiment. With equal amounts of base-out prism placed before each eye, the point of convergence of the lines of sight was moved toward the observer along the midline as in Figure 1. Fusion was maintained throughout the experiment.

Each observer was allowed to practice pointing the "pistol" and "shooting" at various points on the target with either hand until the subject was familiar enough with the arrangement to shoot with reasonable accuracy without sighting.

As a control, the subject was instructed to point toward the cross in the center of the target and take one "shot" at it without base-out prisms before his eyes. This shot was recorded. Following this, and again without base-out prisms, he took two practice shots at the lines at each end of the target and at the center of the target, and again one shot which was recorded, at the center of the target. This procedure was followed until five recorded shots at the target center had been taken with each hand, or 10 recorded shots in all. Each recorded shot was scored as plus if the target was missed toward observer's right or as minus if missed toward observer's left. A hit was recorded as zero. Preceding each shot which was to be recorded, the observer said "now."

After the above 10 control shots had been recorded, the observer, with the maximum base-out prism he could fuse before his eyes, was instructed to take one shot at the target center for recording. After this one shot, the prisms were removed and two practice shots at each end and two at the center were taken. This procedure was repeated until five shots at the center with each hand had been recorded, or 10 in all. Each time the prisms were used only for the one recorded shot at the center

in order to prevent the observer from organizing his projection efforts in relation to the prisms.

TABLE I

Data for 10 subjects showing the average deviation from correct pointing based on five trials, and the average deviations from the averages (in degrees).

Subject	PLANO PRISM Right Hand	PLANO PRISM Left Hand	BASE-OUT PRISM Right Hand	BASE-OUT PRISM Left Hand	Amount of Prism Used (In diopters)
N. B.	+0.5±0.8	+1.4±1.68	—2.0±0.8	—0.2±1.04	32
R. D.	0 ±0.8	+0.4±0.92	—2.4±1.12	—0.2±1.36	25
N. I.	+0.4±0.72	+1.2±0.84	—0.7±1.24	—0.5±2.0	32
P. H.	+0.8±0.64	—0.9±0.88	—0.2±1.36	+2.2±0.32	25
W. R.	—0.9±1.32	—1.1±0.72	—0.3±0.76	—2.2±0.76	35
E. O.	+0.1±0.6	+0.5±0.6	—2.4±1.28	+2.9±1.08	25
V. B.	0 ±0.4	—1.0±1.6	—1.0±0.8	+1.2±2.48	30
D. S.	+0.6±0.72	—0.2±1.25	—0.1±0.92	—1.1±1.08	25
W. J.	+0.1±1.56	+0.9±1.12	—0.4±0.88	—0.5±0.80	34
C. S.	+0.4±1.12	0 ±1.4	+0.8±0.92	+2.5±0.80	25

As is shown by the accompanying records in Table 1, of each subject's efforts, no significant difference is shown between the subject's manifest projection under conditions of this experiment with or without prisms, indicating that a change of position of the eyes induced by equal amounts of base-out prisms before the eyes has no effect on the direction of pointing with either hand.

In each subject's case, a slight tendency is noted by which the subject apparently points more to the left when using the right hand and more to the right when using the left hand, but this tendency is not significantly different with or without prisms.

We might conclude that eye-hand coordination involves no direct connection between the position of the eye in the orbit and the direction in which the hand points: the connection is indirect. One must first locate an object in space by visual clues and the act of pointing with either hand is then controlled solely by the awareness of the position of the object in space.

To formulate the problem in another way, consider the case of a subject who is blindfolded. If the subject voluntarily crosses his eyes or leaves them straight this will have no effect on the direction in which he reaches for an object. Let us now remove the blindfold and place prisms with bases both to the right before his eyes. In this case, he would point to the left of the object, not because the hands follow the eyes to the left but because the turning of the eyes affects the perceived direction of the image, and this, in turn, affects the direction in which the subject points.

Fry, in a recent report[1] pointed out that if a person with base-out prisms equally distributed before the two eyes suddenly points at an object without sighting, he will point to the left of the object with the right hand and the reverse with the left hand. Through personal conference it has been learned that Fry's experiments were qualitative in nature, but he suspected that a quantitative study would have shown that the deviations would be much larger than the present study has shown them to be.

Attention might be called to the fact that, unless care is taken when using the base-out prisms, the image will be perceived to lie much closer to the subject than the physical object. This might introduce error due to the lateral displacement of the two shoulder joints (Figure 4) from

Fig. 4. Possible source of error in pointing. The direction of projection may be correct but an error in perceived distance will introduce an error in the direction of pointing.

the midline. Errors in pointing of this sort are not inconsistent with the explanation of the phenomenon given above.

Appreciation is expressed to the American Optometric Foundation, under whose sponsorship this work was carried out.

[1]G. A. Fry. Am. J. Optom. & Arch. Am. Acad. Optom. 27.11. 531-553. 1950.

ABSTRACTS

STRABISMUS. Hermann M. Burian. Archives of Ophthalmology. 44. (1). 146-154. July, 1950.

An excellent review of the literature on concomitant strabismus is presented and the following aspects are given special attention: etiology, diagnosis and symptomatology, non-surgical treatment or orthoptics, and surgical treatment.

Relative to orthoptics, it is pointed out that this form of treatment can be concerned only with the *acquired* binocular skills and can only assist the patient in developing the best binocular skills of which his eyes and his neuromuscular apparatus are capable. Orthoptics is essentially a teaching process involving the following five steps of learning: attention, awareness, response, satisfaction and repetition.

R. E. B.

AN APPROACH TO PERSONNEL PROBLEMS THROUGH VISUAL PERFORMANCE TESTS*

R. A. Sherman†
Rochester, New York

Visual performance has affected the lives of every one of us. To some extent, it has influenced us in how well we read, how well we work and play, what our incomes are. I am able to support this positive statement because the nine years of continuing research centered at Purdue University has brought to light an abundance of confirming evidence.

Some of the findings which have been made are:

1. Vision is one of the most important functions in occupational performance.[1]

2. Vision includes more than mere ability to distinguish small detail at a distance. Postural tendencies of the eyes in relation to each other and color perception and acuity at near distances are equally important.[2]

3. An instrument such as the ortho-rater, containing a battery of several tests of visual functions, is necessary for the rapid and reliable testing of large numbers of industrial employees.[3]

4. Our old concept of vision, based on an arbitrary standard of its being "good" or "bad," is obsolete.[4, 11]

5. Factors such as attitude, motivation, dexterity, intelligence, health, age, height and weight are important. Visual performance takes on added significance in relation to these factors because something can be done to improve it.

In over 80 per cent of substandard cases,[5] visual performance can be made to conform to desirable patterns through professional services. This leads to improvement in the performance of present employees at their jobs.

6. The old concept of eye protection through safety, or hardened, eyewear should be modified to meet the needs of an over-all safety program. Visual performance is a factor in avoiding accidents. Whatever can be done to enhance a person's visual performance will also help to keep him out of accident situations.

---

*Read before the New Jersey Chapter, American Academy of Optometry, Trenton, New Jersey, as one of a series of lectures on occupational optometry. For publication in the February, 1951, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

†Manager, Occupational Vision Department, Bausch & Lomb Optical Company, Rochester, New York. Fellow, American Academy of Optometry.

Therefore, employees should first be provided with the type of visual performance that is associated with freedom from accidents; next, their improved visual performance should be protected by the best type of safety lenses and frames available.[6]

7. Seeing is something we do. Some people do it clumsily, others skillfully. It is not something that just happens to us.[7]

8. A sound visual performance testing program directed specifically toward such personnel problems as quantity and quality of production, accidents, scrap, training costs, inspection, tenure on the job, health, etc., has proved to be effective and beneficial to both management and employees.[1, 8]

9. A sound visual performance testing program provides a good foundation for a broad personnel testing program.[9]

10. Professionally prescribed and fitted glasses are visual tools which enable even persons with so-called "normal vision" to perform certain tasks more effectively than otherwise possible.[10]

The occupational vision research project at Purdue University is a continuing, cooperative project to which optometry, ophthalmology, management, employees from several industrial companies, Purdue University, and Bausch & Lomb have contributed.

The objective of the research was threefold: first, to discover on a factual basis how important vision is to our occupations; second, to learn how to test the most important factors of visual performance; and third, to determine the method of applying test results most effectively to the personnel problems of management and to the individual seeing problems of the employee.

The first phase of the research covered three years. It showed that arbitrary standards of visual acuity as measured on a wall chart in the average company may or may not have a bearing on employee success on the job. Furthermore, it revealed that other functions of vision, such as acuity measured at distances around 10 to 16 inches, had more relationship to certain jobs than did acuity at 20 feet. And phorias were consistently shown to have a relationship to job success in a large variety of occupations.

The second phase of research was the development of a battery of visual performance tests of high reliability and validity. Twelve of these tests were incorporated in the ortho-rater, which provides a convenient means for rapid testing under standardized and controlled conditions. The validity of the tests was established by more than 2,000 studies of test results and criteria of job success. Development work with the tests continued until reliability proved to be high.

The third phase of research was the building of a program which

would permit each company wishing to use the ortho-rater to validate the tests on its own jobs, and to apply the test results toward its own personnel problems. This investigation resulted in a continuing industrial vision service. Some of its main features are: (1) Organized instruction in standardized test procedures and in the application of test results to each company's needs. (2) The use of ortho-raters as required. (3) Membership in the occupational research center at Purdue University. (4) Consultation with a staff of highly qualified men.

This program is based on a fact-finding orderly plan of procedure which emphasizes demonstrated results to management. Even though it is directed specifically toward the problems of management, one of its most satisfying results has been the testimony of gratitude it has elicited from employees who have been benefited by the program.

The research project at Purdue University has had a profound impact on the public, having made people aware of their need for adequate vision in terms of modern requirements. It has delineated clearly the retardants which have kept such a large percentage of the public from intelligent utilization of ophthalmic services. Some of these retardants are: (1) 20/20 vision is adequate for all jobs. (2) Eyewear is used only to correct a visual defect. (3) Vision is good because eyes are not paining. (4) Bifocals are a sign of old age. (5) Wearing glasses is a sign of weakness.

A vast amount of factual evidence has been gathered to prove the fallacies of these concepts. Using text books containing discussions of the importance of visual performance and the means for improving it, over 150 leading universities and colleges are now teaching a more scientific approach to the subject. This instruction is being given to future molders of public opinion.

We are proud of the part Bausch & Lomb has played in sponsoring this much needed research. It carries to the public the evidence it has needed so badly. It will make your job easier in prescribing what the patient needs for his occupation rather than what he wants because of prejudice.

The program is a beneficial one which builds to the benefit of all concerned and at the expense of no one. Contributions to industry and the employees of industry are very real. The program's good effects reach into every section of the country, rural and industrial. Optometry's contribution has been outstanding. It has opened up vast new opportunities for the extension of necessary ophthalmic services.

REFERENCES

[1]G. Luther Weibel. Industrial Vision Program—Three Years' Operation. The Optometric Weekly, August 12, 1948.

[2]N. C. Kephart. The Important of Phoria Measurements in Industrial Vision. The Optometric Weekly. January 9, 1947.
[3]Fred W. Jobe. Vision for the Job—Instrumentation for the Bausch & Lomb Industrial Vision Service. Bausch & Lomb Magazine. September, 1944.
[4]Hedwig S. Kuhn. Industrial Ophthalmology as of 1946. read before the section on ophthalmology at the Ninety-Fifth Annual Session of the American Medical Association. San Francisco. July 3, 1946.
[5]Joseph Tiffin. Industrial Psychology. Prentice-Hall. Inc., 1947.
[6]N. Frank Stump. How Inefficient Vision Causes Industrial Accidents. The Optometric Weekly. July 4, 1946.
[7]C. F. Shepard. Visual Skills. The Optometric Weekly. January 27, 1944.
[8]Eyes on the Job. The Conference Board Management Record for November, 1947.
[9]John Scott. Jr., How Rocky Mount Mills Uses Visual Tests for Placement. Industrial Relations. August, 1948.
[10]S. Edgar Wirt. Putting Optometric Service to Work for Industry. The Optometric Weekly. October 10, 1946.
[11]Joseph Tiffin and S. Edgar Wirt. An Outline of a Basic Industrial Visual Program as a Guide for Ophthalmologists Who May Be Interested in the Industrial Field. and Near Vs. Distance Visual Acuity in Relation to Success on Close Industrial Jobs. Supplement to the Transactions of the American Academy of Ophthalmology and Otolaryngology. June. 1944.

ABSTRACTS

HOW GOOD ARE EYE EXERCISES? J. D. Ratcliff. Today's Woman. 23 (136). 37-39. 74. 76. 78. 79. February. 1951.

This factual account of eye exercises in a popular magazine by a writer whose articles are reprinted frequently in *Reader's Digest* may well bring to optometrists many inquiries. The author states that: "Many people with mild eye defects can take visual training with a fifty-fifty chance of considerable improvement in sight."

Early in the article is the account of a little girl with detached retina who was given eye exercises for months by "an untrained man" and blindness resulted. However. due credit is given to Professor Samuel Renshaw and his pioneering work during the last war. The author consulted the American Optometric Association and he was referred to Daniel Woolf. O.D., of the faculty of the School of Optometry. Columbia University. The article describes briefly some of the techniques used by Dr. Woolf.

The author also refers to the studies made at Johns Hopkins in Baltimore and at Washington University in St. Louis. In both of these studies optometrists gave the training and the results were checked by ophthalmologists.

The point is stressed that people seeking eye exercises should consult qualified men. In order to determine who is qualified. it is suggested that inquiries be made to the American Council of Orthoptics and the American Optometric Association. (The addresses are included in the article.)

This article represents an extremely honest and fair judgment of the value of eye exercises. It should be read by all optometrists.

R. E. B.

AMERICAN JOURNAL OF OPTOMETRY
and ARCHIVES *of*
AMERICAN ACADEMY OF OPTOMETRY
Established 1924

Vol. 28 February, 1951 No. 2

EDITORS AND STAFF

Dr. Carel C. Koch ..... *Editor*
Dr. Robert E. Bannon ..... *Research Editor*
Virginia Huck ..... *Editorial Assistant*
Harry Brookins ..... *Advertising and Production Manager*
Mary L. Kerr ..... *Circulation Manager*

Publication and Academy Office: 1502 Foshay Tower, 821 Marquette Ave.
Minneapolis 2, Minnesota

Annual Subscription, United States and Canada, $6.00 in Advance: Foreign, $6.50: Single Copies 60c.

Original papers, scientific communications, clinical reports, books for review, and correspondence should be sent to the editor. Subscriptions and applications for single copies should be addressed to the circulation manager. Copy of advertisements must be sent in by the first of the month preceding their appearance. Communications with reference to advertising or other journal business should be addressed to the advertising manager. Academy correspondence should be addressed to Dr. Carel C. Koch, Secretary of the American Academy of Optometry.

Published Monthly by the
AMERICAN JOURNAL OF OPTOMETRY PUBLISHING ASSOCIATION

The American Academy of Optometry and the publishers of this journal have no objection to the reprinting by other magazines of any of the articles in this issue, provided such reprints are properly credited to the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

REFERRALS IN CONTACT LENS CASES

A distinct specialty of contact lens fitting has developed in optometry during the past decade and many optometrists have been especially trained in graduate courses to do this important work. These optometrists have established practices specializing in large part, on contact lens work. During this period, it has become apparent that there exists among optometrists generally, a reluctance to refer contact lens cases to these men—cases which require the services of these optometric specialists.

Just why an optometrist would be reluctant to refer a case requiring specialized contact lens work to a fellow optometrist equipped to perform this service is difficult to understand. The fact remains that

trained and qualified specialists in contact lens fittings who are Diplomates of the contact lens section of the American Academy of Optometry, report that this condition exists, and that a large portion of their present referrals come from professional men in fields other than optometry.

In part this reluctance on the part of optometrists who do little or no contact lens work, may result from their unwarranted embarrassment in admitting to a patient that they are not qualified to do this work even though they must admit by their actions they are depriving their patients of a worthwhile and tested service of merit in certain refractive cases.

In part also, this reluctance may stem from their unfamiliarity with the specialists in the field, or their unwillingness to admit the value of contact lens service in certain cases. Again in either case the patient suffers.

It is also evident that some practitioners refer contact lens cases to lay technicians instead of referring cases to optometrists who are better qualified to do this work than are the lay technicians. In these cases we suspect the referrals are made to the lay technician because the optometrist making the referral feels that the technician has less professional prestige and is therefore less apt to impress the patient with his skill than is a professionally trained specialist doing contact lens work. Here, too, the patient is the loser. In addition, this practice may lead to improper fee splitting or rebating, both practices being forbidden by the Academy.

Patients requiring contact lens work should have it. As the majority of optometrists have had no training in this specialty, these men should properly refer cases requiring contact lenses to optometrists who have had this training. To refer these cases to lay technicians is to place this important professional technique in the hands of untrained lay persons who lack the proper educational background to handle this work.

Optometrists in practice should make use of the specialized skills of those optometrists who have qualified as Diplomates of the contact lens section of the Academy. These men are optometrists who have taken the prescribed graduate courses required of contact lens specialists and who passed qualifying examinations in the specialty of contact lens fitting to assure their colleagues and the public of their proficiency in this field. The Diplomates of the contact lens section of the American Academy of Optometry are the only professionally trained and qualified specialists in the field of contact lens fitting serving the public today. Their offices are located in all parts of the United States.

These men deserve the support of the profession as they are qualified to do this work and in so doing are properly serving the public.

CAREL C. KOCH

THE 1950 ACADEMY MEETING

The annual meeting of the American Academy of Optometry held in Chicago at the Drake Hotel on December 16, 17, 18 and 19, was one of the best in the history of the Academy.

The reports of the president and secretary are presented in this issue. The work of the Executive Council appeared last month. This article aims to give some of the highlights of the program presented at the recent Academy meeting and hopes to point out the remarkable advances in optometry indicated by the character and caliber of the papers read at the Academy meeting.

Each of the sections (aniseikonic, contact lenses and orthoptics) held separate two-hour meetings on three mornings which were devoted mainly to discussions of clinical problems. These meetings were attended by men who are actively engaged in a certain specialty and the exchange of case reports, new techniques, and improved instrumentation afforded an excellent opportunity for bringing up-to-date not only the veteran practitioner but also those men who are beginning to engage in the practices of one of the above mentioned specialties.

The meetings of the pathology section were held as a part of the general program for one hour on each of four days. The four papers presented were primarily of clinical interest. Isadore Kaplan, M.D., of the faculty of the Pennsylvania State College of Optometry, lectured on "Endocrine Disturbances and Their Effects Upon the Eyes." Henry L. Wolfe, O.D., of the Wolfe Eye Clinic, Marshalltown, Iowa, discussed the advantages and limitations of "Scleral Tonometry." Harold Simmerman, O.D. of Pennsylvania State College of Optometry, gave two very interesting and instructive lectures on "Headaches."

Of the 22 papers read before the general session, slightly more than half were of considerable practical interest to the practitioner and the remaining papers reported upon the results of various research projects completed recently. There were individual papers on illumination, reading difficulty, optometric education, history of the ophthalmoscope, the role of the optometrist in industry, and of timely interest and concern was an excellent paper on "The Optometrist and War-time First Aid."

The optometry schools were well represented on the program with one or more papers from practically every school. The Academy was particularly fortunate to have Dr. Henry A. Imus of the Office of Naval

Research as the principal banquet speaker. Dr. Imus spoke on "Fundamental Research in Vision" and reviewed several projects that have been conducted under Navy aid and encouragement. Many of these projects bore results which are applicable to ophthalmic practice as well as contributions to our knowledge of the fundamental aspects of visual science.

In general, the recent Academy meeting was a great success as those who were present have attested. We are grateful for the efforts of the various lecturers who made the program such an excellent one and who, by the material they presented, give evidence of the great strides which optometry is fast making toward becoming a science of vision.

ROBERT E. BANNON.

TRANSACTIONS OF THE AMERICAN ACADEMY OF OPTOMETRY

A department devoted to announcements, reports, appointments, organization data, news, professional problems and ideals, as these relate to the Academy.

ANNUAL REPORT OF THE PRESIDENT*

D. G. Hummel†
Cleveland, Ohio

It was my belief on taking office that the Academy had progressed so rapidly it was time it paused to view its position and consolidate its gains. This was an erroneous thought. Consolidation, we found, meant progress and the Academy principles were too vital to allow any pause in its progression. This then, is a report of those principally responsible for this progress with some recommendations for the future.

The business of the Academy is run through the secretary's office and this is as it should be. The result with the present secretary, Dr. Carel C. Koch, has been to establish the Academy on the firmest ground. From his previous reports and today's, you will realize only a small part of the tremendous task that he does so well.

Never before have I felt that the Academy's position has been more secure and for this Dr. Koch should receive the greatest credit.

In the annual report of last year the Fellows were requested to give preference to the *American Journal of Optometry and Archives of the*

*Read before the annual meeting of the American Academy of Optometry, Chicago, Illinois, December 16, 1950.
†Optometrist. Fellow, American Academy of Optometry.

American Academy of Optometry in the publication of their original papers. The response has been gratifying with the resultant enrichment of scientific literature. As a textbook of the profession your Journal is in a class by itself but pride alone will not continue its position. Your continued support is urged.

The program committee with Dr. Robert E. Bannon as chairman has again done a tremendous job. This year's program should even excel last year's. It is not an easy task to plead for papers, arrange to try and satisfy everyone and in some instances, have to refuse time on the program. I am proud of the work done by Dr. Bannon, as I was of his predecessor, Dr. Harold Simmerman. Each of them has done better than myself.

Each year has seen the section sessions more firmly established. When the idea of the sections was first proposed it was not generally agreed that they would be of value. Time and the caliber of the Fellows interested have made these specialized meetings a valuable and integral part of our annual meetings. It has become evident that these meetings are the teaching portion of our program.

It is now proposed that we add a fifth section, that of "Industrial Vision." That the need is evident seems clear. The same reasons prompt this proposal as in the already established sections: education and professional responsibility by the exchange of facts.

Outside of the funds necessary for the normal routine of any organization the remainder of the Academy income has been used to defray the expenses of research. In particular you are urged to listen to the report of the chairman of the committee on research, by Dr. Meredith W. Morgan, Jr., chairman. For the money spent by the Academy the returns are far greater than could ordinarily be expected. This could only be accomplished by the zealous interest and devotion to research of those Fellows who are educators. Because the Academy's fine record of the use of its funds is worthy of commendation, I would remind you again that we will accept funds to be used for research.

At one time there was considerable concern on my part as to the status of the chapters—the possibility of the tail wagging the dog was a distinct possibility. This is no longer a problem. The chapters are on a firm foundation and add greatly to the purpose and prestige of the Academy. Under the able chairmanship of Dr. Lawrence Fitch the establishment of new chapters has progressed rapidly. His advice and counsel have made it possible for new chapters to avoid many errors of the past. Recently the Executive Council received an application for the establishment of a chapter in Great Britain. We are honored and I believe the application should be accepted.

Most of you are unaware of the vast amount of work required of the committee on admittance. This is a year-round job for anyone. Dr. Arthur P. Wheelock and his committee have shown the unusual patience and wisdom that the job requires. We owe them a great debt.

The Academy has been requested to send a representative to The International Congress of Ophthalmic Opticians to be held at Kings College in London, England, in July, 1951. This is a well deserved honor and we should accept the invitation.

Even in an organization such as ours it is sometimes difficult to obtain individuals willing to start at the bottom and learn the necessary business of the Academy so that in future years they might accept the greater responsibility of membership on the Executive Council. With this in mind more than a year ago the chairmen of the various committees were requested to evaluate the interests and abilities of the Fellows under them. It is gratifying to report that with this in mind and its continuation, the Academy is assured of sufficient numbers of those willing to sacrifice their time for the greater good.

It has been a pleasant and enlightening experience to work with your present officers. They are to be congratulated for their independent thinking and team work. To all of them and the various committee members my thanks and appreciation. To my successor, may I say—now that my apprenticeship has been served I hope to do a better job for the Academy.

ANNUAL REPORT OF THE SECRETARY*

Carel C. Koch†
Minneapolis, Minnesota

Under the excellent leadership of President D. G. Hummel, the Academy has concluded another successful year. Continued progress has been made in advancing the professional aspects of our work as well as in the technical phases of optometry. In addition, the Academy, through its hard-working Executive Council, has aided the profession in forming new, and we feel beneficial, interprofessional relationships.

We are happy to welcome to these sessions the representatives of the National Interprofessional Committee on Eye Care who are meeting here in Chicago during this Academy session. We also welcome the

*Read before the annual meeting of the American Academy of Optometry, Chicago, Illinois, December 16, 1950.
†Optometrist. Fellow, American Academy of Optometry.

American Board of Opticianry. This group is the chief educational co-ordinating body in opticianry.

MEMBERSHIP

Since our last meeting in Cleveland, Ohio, Academy Fellowship certificates have been issued to 27 optometrists, educators and scientists. On December 1, 1950, the membership of the Academy numbered 523. This is the high point in Academy membership and indicates the strength of this technical society.

Since our last meeting I regret to report that the Academy has lost six members through death. Each of these men played a significant part in the development of the profession and each has left his important mark on the present and future of optometry. All have been active in the Academy. One served as president in 1934 and 1935. Another as Academy vice president in 1940. Another as secretary of the Canadian Optometric Association and editor of the *Canadian Journal of Optometry*. We miss these important leaders, and at this time we pause to pay tribute to Dr. Edward Bind, Toronto, Ontario; Dr. Elmer E. Hotaling, New York, New York; Dr. A. G. McCullar, Lewisburg, Tennessee; Dr. Charles P. Nelson, Minneapolis, Minnesota; Dr. J. A. Seifert, Detroit, Michigan and Dr. Robert N. Walker, Winston-Salem, North Carolina.

During this same period the Academy accepted with regret the resignations of Dr. R. S. Jordan, Cleveland, Ohio; Dr. F. J. Kellogg, Mason, Michigan; Dr. Milton H. Lebson, Hackensack, New Jersey; Dr. C. E. Lonsway, Cleveland, Ohio; Dr. Matthew Luckiesh, Cleveland, Ohio; Dr. A. G. McDonald, Washington, D. C.; Dr. C. W. Morris, Fort Wayne, Indiana; Dr. A. T. Price, Trenton, New Jersey; Dr. Franklin P. Seward, New York, New York and Dr. Claude A. Warner, Baltimore, Maryland.

COMMITTEE ON ADMISSIONS

Under the direction of Dr. Arthur P. Wheelock, Des Moines, Iowa, the examining board and its regional committees have perfected the admittance procedures which were materially changed during a revision of the constitution several years ago. This exacting work is now functioning smoothly and Dr. Wheelock and his committee deserve the sincere thanks of the entire membership. This committee of regional chairmen includes Dr. Oscar L. McCulloch, Region I; Dr. Arthur S. Kitchen, Clearwater, Florida, Region II; Dr. E. E. Reese, Westerville, Ohio, Region III; and Dr. Otto J. Bebber, Denver, Colorado, Region IV. Dr. Kitchen filled the vacancy left by the death of Dr. Robert N. Walker of Winston-Salem, North Carolina. Each of the regional committees has

done a splendid job, and they have been assisted by the sub-examining boards at the chapter level. As of December 1, 1950; 160 applications for Fellowship were on file.

PAPERS AND PROGRAM COMMITTEE

This report calls attention to the splendid work of the papers and program committee which arranged the lecture program at Cleveland, Ohio, last year, and the outstanding program we will enjoy here in Chicago. This work has been under the supervision of Dr. Robert E. Bannon, Hanover, New Hampshire. Dr. Bannon was assisted by Dr. Eugene Freeman, Chicago, Illinois; Dr. Jack Copeland, Chicago, Illinois; Dr. Henry W. Hofstetter, Los Angeles, California and Dr. F. William Sinn, Philadelphia, Pennsylvania, as well as the section chairmen: Dr. Harold Fisher, New York, New York, aniseikonia; Dr. John Neill, Philadelphia, Pennsylvania, contact lens fitting; Dr. J. Donald Kratz, Philadelphia, Pennsylvania, orthoptics, and Dr. W. O. Vivian, Media, Pennsylvania, pathology.

RESEARCH PROJECTS

During 1950, the Academy, through an allotment of funds by the research projects committee, assisted studies conducted at the Los Angeles College of Optometry and the School of Optometry, University of California. Dr. Meredith W. Morgan, Jr., Berkeley, California, will report in detail on these projects, as well as proposals for Academy grants in 1951.

EDITORIAL COUNCIL

As is the Academy policy, the original papers which were presented at our 1950 annual meeting were presented to the profession in the official publication of the Academy. In addition, a large number of published monographs were supplied to educators for classroom work and individual studies.

CHAPTERS

The start of 1950 found the Academy with 17 active local chapters. During the year, applications for chapters were received from Up-State New York, England and the San Francisco Bay area of California. These applications have been approved by the Executive Council and we now have 20 chapters serving the membership at the local level.

FISCAL POSITION OF ACADEMY

Following our 1949 meeting, the secretary's office prepared the 1950 annual budget which was submitted to, and approved by the Executive Council. The secretary's report to the membership in the form of the Academy balance sheet of November 10, 1950, reported

the current fiscal position of the Academy. I am pleased to report to the membership that the finances of the organization are adequate to meet the current requirements.

CONCLUSION

In closing this annual report I wish to express my sincere appreciation to the Executive Council, the standing committees, sections and chapters of the Academy. All have been most cooperative and helpful and have made the conduct of the secretary's office a real pleasure. I particularly wish to express my appreciation to our president, Dr. D. G. Hummel, for his constructive assistance and ever present leadership. We have been in daily contact and he has never permitted anything to interfere with his Academy responsibilities. I also wish to express my appreciation for the encouragement and help received from our vice president, Dr. Harold Simmerman of Woodbury, New Jersey, across whose desk has passed all Academy correspondence, and whose comments and advice have been of value to us all.

The work done by the Academy during the past 30 years is now showing major results. The professional future of optometry is assured. Our future has never looked brighter. The loyal membership of the Academy may well feel proud of the important part they have played in placing optometry in the accepted circle of major health professions.

ACADEMY COMMITTEE APPOINTMENTS FOR 1951

Dr. Harold Simmerman, president, reports the following Academy committee appointments for 1951:

ADVISORY COUNCIL

Dr. D. G. Hummel, Cleveland, Ohio, chairman; Dr. Harold Fisher, New York, New York; Dr. J. Fred Andreae, Baltimore, Maryland; Dr. Walter I. Brown, New Bedford, Massachusetts; Dr. Richard M. Hall, Cleveland, Ohio; Dr. Carel C. Koch, Minneapolis, Minnesota; Dr. Don R. Paine, Topeka, Kansas; Dr. M. Steinfeld, Paducah, Kentucky; Dr. Arthur P. Wheelock, Des Moines, Iowa; and Dr. Eugene Wiseman, Buffalo, New York.

EDITORIAL COUNCIL

Dr. Harold Fisher, New York, New York, chairman; Dr. Carel C. Koch, Minneapolis, Minnesota; Dr. Robert E. Bannon, Hanover, New Hampshire; Dr. I. M. Borish, Kokomo, Indiana; Dr. V. J. Ellerbrock, Columbus, Ohio; Dr. Richard Feinberg, Forest Grove, Oregon; Dr. Eugene Freeman, Chicago, Illinois; Dr. Glenn A. Fry, Columbus, Ohio; Dr. Henry W. Hofstetter, Los Angeles, California; Dr. D. G. Hummel, Cleveland, Ohio; Dr. J. Donald Kratz, Souderton, Pennsylvania; Dr. Leo F. Madigan, Boston, Massachusetts; Dr. Meredith W. Morgan, Jr., Berkeley, California; Dr. John C. Neill, Philadelphia, Pennsylvania; Dr. Harold Simmerman, Woodbury, New Jersey; Dr. William O. Vivian, Media, Pennsylvania, and Dr. Gordon L. Walls, Berkeley, California.

PAPERS AND PROGRAM COMMITTEE

Dr. Meredith W. Morgan, Jr., Berkeley, California, chairman; Dr. I. M. Borish,

Kokomo, Indiana; Dr. Isidore Finkelstein, New York, New York; Dr. Henry W. Hofstetter, Los Angeles, California; and Dr. F. W. Sinn, Philadelphia, Pennsylvania.

COMMITTEE ON STUDENT COUNSEL

Dr. R. W. Tubesing, Richmond, Indiana, chairman; Dr. V. J. Ellerbrock, Columbus, Ohio; Dr. Richard Feinberg, Forest Grove, Oregon; Dr. H. W. Hofstetter, Los Angeles, California; Dr. George W. Keevil, Toronto, Ontario, Canada; Dr. Harold Fisher, New York, New York; Dr. Eugene Freeman, Chicago, Illinois; Dr. George J. Haus, Memphis, Tennessee; Dr. O. L. McCulloch, Holyoke, Massachusetts; Dr. Meredith W. Morgan, Jr., Berkeley, California; Dr. Richard Needles, Chicago, Illinois; Dr. Julius Neumueller, Haddonfield, New Jersey, and Dr. Martin Snook, Newton, New Jersey.

COMMITTEE ON ADMITTANCE

Reappointed general chairman of the committee on admittance, Dr. Arthur P. Wheelock, Des Moines, Iowa. Regional committeemen are as follows:

Region 1. Dr. O. L. McCulloch, Holyoke, Massachusetts, chairman; Dr. William G. Walton, Jr., Merion, Pennsylvania and Dr. Bernard A. Baer, Washington, D. C.

Region 2. Dr. Arthur S. Kitchen, Clearwater, Florida, chairman; Dr. Donald A. Springer, Anniston, Alabama and Dr. J. T. Campbell, Washington, North Carolina.

Region 3. Dr. E. E. Reese, Westerville, Ohio, chairman; Dr. I. M. Borish, Kokomo, Indiana, and Dr. Rudolph Ehrenberg, Granite Falls, Minnesota.

Region 4. Dr. Otto J. Bebber, Denver, Colorado, chairman; Dr. J. Wolff, Spokane, Washington, and Dr. Monroe J. Hirsch, Los Angeles, California.

CHAPTERS AND NEW CHARTERS COMMITTEE

Dr. Lawrence Fitch, Philadelphia, Pennsylvania, chairman; Dr. A. G. Billmeier, Denton, Maryland; Dr. W. I. Brown, New Bedford, Massachusetts; Hon. Lord Charnwood, London, England; Dr. William L. Cheatham, Jr., Houston, Texas; Dr. Richard Feinberg, Forest Grove, Oregon; Dr. E. J. Fisher, Toronto, Ontario, Canada; Dr. John J. High, Rocky Mount, North Carolina; Dr. H. B. Hewett, Lake Charles, Louisiana; Dr. O. H. Johnson, Jonesboro, Arkansas; Dr. H. I. Moss, Wilmington, Delaware; Dr. R. C. Phillips, New Brighton, Pennsylvania; Dr. John J. Wey, Painesville, Ohio; Dr. Ernest C. Wille, Jr., Denver, Colorado; Dr. E. C. Wilson, Rutland, Vermont, and Dr. J. Wolff, Spokane, Washington.

SECTION APPOINTMENTS

CONTACT LENS SECTION AND CONTACT LENS EXAMINING BOARD

Dr. John C. Neill, Philadelphia, Pennsylvania, chairman; Dr. Irving P. Filderman, Memphis, Tennessee; Dr. Isidore Finkelstein, New York, New York; Dr. V. J. Ellerbrock, Columbus, Ohio; and Dr. Meredith W. Morgan, Berkeley, California.

SECTION ON ANISEIKONIA

Dr. Leo F. Madigan, Boston, Massachusetts, chairman; Dr. V. J. Ellerbrock, Columbus, Ohio; Dr. Bernard Mazow, Houston, Texas; Dr. Oscar L. McCulloch, Holyoke, Massachusetts, and Dr. Kenneth B. Stoddard, Berkeley, California.

SECTION ON PATHOLOGY

Dr. William O. Vivian, Media, Pennsylvania, chairman; Dr. Z. J. Schoen, Chicago, Illinois; Dr. I. Irving Vics, Albany, New York, and Dr. Henry L. Wolfe, Marshalltown, Iowa.

SECTION ON ORTHOPTICS

Dr. J. Donald Kratz, Souderton, Pennsylvania, chairman; Dr. Daniel Woolf, New York, New York; Dr. S. Winfield Smith, Wilmington, Delaware; Dr. Milton N. Chodroff, New York, New York; Dr. Arthur Jampolsky, San Francisco, California, and Dr. Wilma Baber, Los Angeles, California.

CURRENT COMMENTS

Virginia Huck
Editorial Assistant

Optometrists will confer a favor by sending news items of general interest for this department; such as relate to new instruments, clinical techniques, education, visual health and optometric legislation and organization.

STUDENT DEFERMENTS

A deluge of calls and letters has flooded the Journal office since our announcement of the appointment of Editor Carel C. Koch by General Lewis B. Hershey to the healing arts educational advisory committee of Selective Service. The queries have come from individuals and optometric schools asking about student deferments, and stem from the fact that Selective Service had been slow in getting its optometry directive to the draft boards, in accordance with Public law 779, which directive was promised before the end of 1950. The Selective Service directive relating to student deferment—Operations Bulletin No. 22, was sent to the draft boards on February 6.

At the time of this writing, Bill H. R. 1752 has been proposed in Congress. This administration Selective Service measure is, I am told, far from satisfactory on a number of counts. The bill is a hybrid one, made up partly from recommendations of the Selective Service advisory committees, the recommendations of those favoring universal military training, and the demands of certain administrative leaders in Washington associated with federal aid to schools.

In its present form, H. R. 1752 is probably unworkable and certainly will please no one. It will have to undergo a series of drastic changes to do so.

While this new measure provides for the continuance of approximately 75,000 undergraduate and graduate students each year, the bill does so, after a probable four months basic military training period, and the bill is not clear as to who shall select these students or what courses they may take to secure deferment.

Dr. Joseph Babcock and William MacCracken are again leading the A.O.A. department of national affairs in studying this entire question. It is anticipated that optometry's place in this picture will become clarified before the law is enacted.

In the meantime, while the question of student deferment is in doubt for the next school year, the advice of our leaders to our undergraduate students is to stay in college for the time being. The uncertainties surrounding this new legislation will be resolved well before June 1, and students' future plans can then be made.

ADDITIONAL ACADEMY CONVENTION NEWS

An association of military reserve officers was organized during the recent annual meeting of the Academy, to function for the interest of optometrists in the national emergency. Elected president, Dr. Eugene Strawn, Freeport, Illinois; secretary-treasurer, Dr. D. R. Reed, La Porte, Indiana; executive council, the officers and Dr. Harold Fisher, New York City, (Armory), Dr. Elwin Marg, Berkeley, California (Air Corps) and Dr. John E. Martin, Carroll, Iowa, (Navy).

Through Mr. Sylvester Guth, the Illuminating Engineering Society of America extended to individuals of the Academy an invitation to become Society members. Said Guth, in addressing the Academy, in Chicago, "The aims of the Academy and the Illuminating Engineering Society are the same—a humanitarian approach to better living. All individuals of the Academy are eminently qualified to become members of the Society and contribute further to this aim."

OPTOMETRY AND DEFENSE

Press releases since January 1, look for all the world like those received by our office in the early '40's. Optometric groups have switched their attention to optometry's role in the national emergency, and visual problems in industry are again taking the spotlight.

An occupational vision conference is scheduled for April 1-4 on the campus of Northern Illinois College of Optometry, with a program on defense problems under the direction of Dr. Elmer H. Westland, Ambridge, Pennsylvania. The meeting is to be sponsored jointly by the American Optometric Association and N. I. C. O.

"Save Your Vision For Defense" is the theme of the American Optometric Association's 25th annual special vision week March 4-10. All promotional publicity will be aimed at optometry's role in defense, according to Dr. Elmer Soles, A. O. A. public relations director.

The Better Vision Institute will focus attention in 1951 on the "crucial importance of better vision for better defense" but with no slackening of the general publicity and educational activities aimed toward consumer goodwill.

OPTOMETRISTS IN THE NEWS

The honorary degree of Doctor of Ocular Science was conferred on two optometrists by Chicago College of Optometry at their fifth commencement, in recognition of outstanding contributions to optometry. Receiving degrees from Dr. Eugene Freeman, dean, were Dr. Robert E. Bannon, research editor of the *American Journal of Optometry* and private practitioner in Hanover, New Hampshire, and Dr. Winifred Held, R. N., O. D., Chicago.

Dr. Bannon gave the commencement address at the exercises which were held the evening of February 2.

On the same evening, graduation exercises also took place at Northern Illinois College of Optometry, where an honorary D. O. S. was awarded Dr. Jerome B. Conlogue, Peoria, Illinois. Commencement speaker was Dr. Harry E. Pine, Chicago, Illinois.

At the 36th meeting of the board of directors of the Optical Society of America, Incorporated, Dr. Glenn A. Fry, dean of the School of Optometry, the Ohio State University, was reappointed O. S. A. representative on the Inter-Society Color Council for a term to expire in October, 1952. He was also appointed associate editor of the *Journal of the Optical Society of America*, to serve until December 31, 1953.

Recently elected 1951 officers of the Hawaii Optometric Association are Dr. Harold Lam, president; Dr. R. B. Botkin, vice president; Dr. George Buto, secretary-treasurer; Dr. Y. F. Look, corresponding secretary; Dr. Robert Kikawa, auditor; and Drs. D. B. Gould and Dr. Walter Togikawa, members of the executive board.

A condensation of Dr. Harris Gruman's book, "New Ways to Better Sight," appeared in the Spring issue of *Better Health*.

Now appearing in *Today's Woman* is an article on orthoptics, "How Good Are Eye Exercises," illustrated with photographs taken in Dr. Daniel Woolf's New York office. The article, written by science writer John D. Ratcliff, concludes that "many people with mild eye defects take visual training with a 50-50 chance of considerable improvement in sight."

While Mankato, Minnesota, recently was naming Dr. S. R. Tillisch "outstanding young man of 1950," Darlington, Carolina, was doing the same for Dr. Ned Hobbs. Both awards were in recognition of outstanding civic and professional work.

CAMPUS NOTES

The Palm Terrace Room of the Beverly Hills Hotel was the setting for *Los Angeles College of Optometry's* recent study and review of the "aesthetic, artistic and cosmetic factors in modern ophthalmic design," planned for the practicing optometrist. Recognizing that a proper study of fashion and style as an important phase of the total service offered by optometry, cannot be adequately made in the classroom and library, the college arranged, with the aid of several ophthalmic manufacturers and laboratories, to take the study to its proper setting—in this case, an elaborate stage production with professional models illustrating the educational and technical commentary. Continental Optical Company, Tura, Inc., and the ophthalmic Laboratories

of Greater Los Angeles contributed to the expenses of the program.

GRANTS AND SCHOLARSHIPS

The Stanford University School of Medicine was the recipient of a $3,500.00 grant from the National Society for the Prevention of Blindness, for two research projects. Amblyopia ex anopsia and congenital cataract will be investigated with the funds, allocation of which were announced by Dr. Franklin M. Foote, executive director.

The Educational Foundation in Ophthalmic Optics has announced the awarding of twelve $100.00 scholarships to students in opticianry attending the University of New York, Los Angeles City College and Rochester Junior College. The Foundation is under the supervision of the American Board of Opticianry.

THE PATIENT

Sure chuckles for your patients (and yourself) are in Bausch & Lomb's 32-page booklet of baby pictures with humorous captions characteristic of spectacle wearers. The booklet is for reception room use, and while it must be seen to be appreciated, you can imagine its contents if you've seen the famous Constance Bannister baby photos with clever comments in the book, "The Baby." The pictures in B & L's booklet are by Constance Bannister and H. Armstrong Roberts. Write for your copy to Bausch & Lomb, Rochester, New York.

NEWS BRIEFS

Frame fashions for '51—Bay State's Rough Rider, designed for children, with shields of horses' heads and six-shooters; additional attraction, a special holster-type spectacle case with belt loop. Art-Craft Optical Company's "Art-Brow," combination zyl and metal, made for both men and women in seven shades of zyl. . . . Dr. Derrick Vail, Chicago, ophthalmologist, and editor of the *American Journal of Ophthalmology*, and Dr. Carel C. Koch, editor of this Journal, will be two of the speakers at the 43rd annual convention of the Illinois Optometric Association, February 25, 26. . . . The first issue of the *Canadian Journal of Optometry* published under the direction of its new editor, Walwyn S. Long, is off the press. The magazine is now a bi-monthly publication. The January-February issue is in part, a memorial to Dr. Edward Bind, former editor who passed away last July. . . . The Walman Optical Company, Minneapolis, Minnesota, has become the exclusive Northwest distributor of the Mueller Welt fluidless contact lens, which originated in Germany. The company emphasizes that this lens does not replace their present fluidless corneal lens, but rather adds to their available service. . . . CARE (UNESCO)

is currently appealing for ophthalmology books for the Schell Eye Department of the Christian Medical College and Hospital, Vellore, India. Contributions should be sent to the Book Fund, CARE, 20 Broad Street, New York, New York, which has titles of the needed books on file. . . . Facts on the economic phases of professional practice are illustrated in Bausch & Lomb's new brochure, "Your Future—Your Choice." For a graphic picture of the current ophthalmic economic situation, write for the booklet. . . . Dr. Thaddeus R. Murroughs, director of research, Chicago College of Optometry, was the featured speaker at the 46th annual convention of the Alabama Optometric Association, in January. . . . Correction: The 42nd anniversary conference of the National Society for the Prevention of Blindness will be held at the Hotel New Yorker, New York City, on March 28-30. Incorrect dates were announced last month by the Society. . . .

Harry C. Ray, advertising manager for the past 28 years of the American Optical Company, has announced his retirement from the company. He has worked for the A. O. company since 1910. Arne J. Oker, formerly assistant advertising manager, moves into Ray's post. . . . Dr. Herman L. Klein, beloved president of the Massachusetts College of Optometry, who on January 4 formally dedicated the new Horace Mann Building, died suddenly on January 22. He was 74, and one of the oldest practicing optometrists in Boston at the time of his death.

L. A. OPTOMETRISTS HELP BOYS' CLUB

Something unique in the line of community projects is currently absorbing the interests of members of the Los Angeles County Optometric Association. Through the efforts of Dr. Ed Goodlaw, the Association became interested in setting up a visual program for the Los Angeles Times Boys' Club, whose membership includes many youngsters from underprivileged homes. The optometrists work in teams two nights a week examining the boys, all on a volunteer basis. Dr. Goodlaw had no trouble persuading his associates to work in the clinic, as all members feel they are contributing not only to individual well being, but community welfare as well.

Recently this work of the Association was featured in the Los Angeles *Times*, which told the story of one Boys' club member who was inadvertently labelled "maladjusted" until a visual problem was discovered by one of the volunteer optometrists during an examination. Now the boy is getting the treatment needed, and learning to live with his friends and playmates. The Los Angeles College of Optometry has also cooperated with the project, contributing the use of its clinic.

BOOK NOTICES

LIGHT, VISION AND LENSES. G. W. Knox and V. J. Ellerbrock (School of Optometry, Ohio State Univ.). Distributed by The Scioto Printing Co., Columbus, Ohio. 350 pp., 264 illustrations, $6. 1950.

This is an introductory text-book of geometrical, physiological and ophthalmic optics. It is divided into three parts: Light, Vision and Lenses, containing in all, 245 separate sections which are well illustrated by 264 figures.

The book is prepared especially for, and should be found useful by, optometry students, graduate optometrists who wish a refresher in basic and applied principles; as well as for those in the related fields of ophthalmology, illuminating engineering, psychology, opticianry, optical salesmen, and anyone interested in an overall picture of visual science from the view-point of the eye specialist.

Part I covers the subjects of radiation, illumination, color, reflection, refraction, the use of prisms, mirrors and lenses and the various aberrations of lenses. The use of mathematics and formulas is minimized, and the fundamental principles of geometrical optics are demonstrated by numerous well-executed diagrams.

The beginning of Part II deals with ocular anatomy and pathology. This is followed by a description of the refractive anomalies together with the objective and subjective methods of examination. An attempt is made to give the reasons behind the clinical procedures, rather than to indicate any system of detailed steps of examination. Binocular problems involving phorias, fusional movements and their measurements constitute several chapters. The principles employed in determining a final prescription are discussed. The last chapter in this section is devoted to a discussion of psychological factors in vision such as: constancy, effects of learning and memory, etc.

The manufacture of ophthalmic lenses is discussed clearly and succinctly in Part III. The chapters are devoted to unifocal and multifocal lenses. Other chapters are given to prismatic power, magnification properties, refractive power, lens systems, and mechanical characteristics of lenses and prisms. Included also are chapters covering the basic specifications of lenses, spectral transmission of ophthalmic glass, magnifying and minimizing units, and contact lenses. Finally, there is an instructive discussion of problems encountered in proper fitting.

In general, this well written and well illustrated book should find a welcome audience among those beginning the study of clinical optometry and/or ophthalmology as well as those who wish a composite pic-

ture of the various aspects of visual science with which the eye specialist is concerned.

ROBERT E. BANNON.

BEGINNING EXPERIMENTAL PSYCHOLOGY. S. Howard Bartley, Ph.D. (Michigan State College). McGraw-Hill Book Co., Inc., 330 West 42nd St., New York, N. Y. 438 pp. 123 illustrations. $4.

This is one of the few texts in this field that was written primarily as a textbook for a college course in experimental psychology but, due to the choice of materials and the manner of presentation, the book will serve several other purposes well. Professional men as well as alert laymen can gain helpful facts and viewpoints from reading its many short and clearly written chapters.

The book is not the usual compendium of passing remarks about a host of matters, but includes portions representing a variety of fields. It is built upon the supposition that experimental psychology is not the highly specific field that it was during the early days of modern psychology, but that it is all the psychology that has been derived by the use of scientific method. Topics are dealt with by extended example and these possess clarity and meaning not attained by the few other current textbooks on the subject that are devoted largely to the psychology of learning.

The text contains 48 short chapters, and a goodly number of these pertain to matters of perception. The portion of text that will interest optometrists are the chapters on the sensory processes, or with what the author calls the organism's contact with the physical world. Each chapter is an account of one or two recent representative investigations in a given field. Enough exposition detail, aided by well-executed illustrations, is given for the unversed reader to be able to follow the reasoning and procedures used in the investigations described.

In some chapters the material is not wholly new to the optometrists but the author's presentation will make for much better understanding in terms of human behavior.

For example, one chapter is devoted to the description of the effects of size-lenses. Another chapter deals with the measurement of distortions in visual space by use of the space-eikonometer. Other chapters are devoted to investigations on the relations between space perception and sound perception; motion sickness; visceral factors in ordinary dizziness, etc.

Every practitioner should be interested in understanding human

perception in order to deal with the problems he meets so frequently. Bartley's text provides materials somewhat different than often contained in formal courses on the subject, and in that way forms a basis for the stimulation of thinking about perception in directions not induced by most other means at the command of the average optometrist.

ROBERT E. BANNON.

COLOR PSYCHOLOGY AND COLOR THERAPY. B. Birren. McGraw-Hill Book Co., Inc., 330 West 42nd St., New York, N. Y. 284 pp. 1950.

This book represents an attempt by the author to accomplish two ends. One, to assemble the findings of published reports on color psychology and color therapy, especially as they are related to the cure of human ills, physical or mental. Two, with the evidence so brought together, to appeal to science and the medical profession to abandon old prejudices and to give color renewed consideration.

The material presented in the book is divided into four parts. In the first part an extensive study is made of the charlatans who professed knowledge of color therapy, of the amulet wearers, the aural healers and the eager chromopaths of the past. The second part is devoted to the biological aspects of electromagnetic energy with particular reference to the visible wavelengths. Here, the physiological effect of color on plants, invertebrate and vertebrate animals and human beings is considered. The psychological effects of color including emotional reactions, associations and conditioning comprise the third part. Part Four of the book has to do with the organ of sight and the mechanism of vision itself. In this part attention is paid to the adverse effects of eye fatigue, eyestrain, and abuse of the eyes. Also, consideration is given to the specification of colors for hospitals, homes, airplanes, ships, factories, etc.

What is the nature of the evidence provided in support of the physiological effects of color? At the end of Part Two the author states "from a series of experiments it was found that yellow and purple light had the best effect upon human metabolism. Red tended to weaken it considerably and green slightly. The influence of color, weak or strong, also depends upon whether it is seen as brilliant or dim. The pulse is generally slower in darkness than in bright illumination—regardless of the colors involved. Thus the application of color therapy must contemplate not only here but illumination intensity." With this reference, no specification is given of the quality or quantity of wave lengths employed, the application of the radiation, the experimental controls and the numerous other questions which would have to be

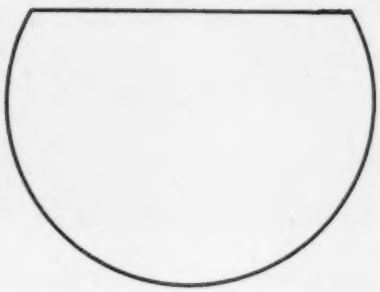
answered before such a reference could be accepted as fact.

In Part Three, a generalization of the so-called psychology of color is provided. The author states that "One could say that red is inciting to activity and favorable for emotionally-determined actions: green creates the condition of meditation and exact fulfillment of the task. Red may be suited to produce the emotional background out of which ideas and action will emerge: in green these ideas will be developed and the actions executed." The original statement of this generalization was made by Kurt Goldstein. In this book it is taken at face value and serves as the major basis for specification of red and green provided in the fourth part.

From a study of all the evidence offered by the author for the significance of a given color and its specification for various uses, one is forced to conclude that in general it is untenable and noncredulous. That specific points in the book are substantiated by adequate and reliable evidence cannot be denied. In fact, the section on the visual aspects of seeing and anomalies of vision are scientifically correct and very well written. However, for the purposes for which the book was written it adds only additional confusion to the subject.

V. J. ELLERBROCK.

PUBLISHER'S NOTICE — A special subscription service has been arranged to assure subscribers in military service of receiving their copies of this magazine each month. Subscribers are urged to immediately forward changes in their military addresses as these occur, giving name and rank, service unit, hospital, camp, naval port or air base. Also previous address. Journals will be individually forwarded to men in service irrespective of the number of month-to-month changes that occur.



NOW!

a new member of the Soft-Lite neutral absorption family . . .

Soft-Lite S-T Bifocals

a new STRAIGHT-TOP made by BAUSCH & LOMB

It's ready! For the first time, there is a straight-top bifocal available *in genuine Soft-Lite glass.* Known as the "SOFT-LITE S-T", it is the ultimate in flat-top bifocal performance for those who prefer this type of lens.

Leading Soft-Lite supply houses have this new member of the Soft-Lite bifocal family in stock—or they will soon have it available. Meanwhile, when a representative calls with a sample of the Soft-Lite S-T Bifocal, we suggest you examine it closely. You'll see many superior features . . . compared to other bifocals of this type. They all add up to "the finest of the flat-tops!"

SPECIFY

Soft-Lite S-T

STRAIGHT-TOP FEATURES

1. Exclusive—Orthogon correction for marginal astigmatic error.
2. Exclusive—Soft-Lite neutral absorption for comfort and true color values.
3. Exclusive—Baryta glass segment and distance portion of Nokrome Crown glass.
4. Advanced methods of manufacture for greater depth of focus, dividing line invisibility, freedom from distortion, and clarity of vision.
5. Matched-pair segments, 20mm or 22mm diameter, inset 2mm.
6. Large, square blanks to take care of 99% of straight-top prescriptions.

Soft-Lite Lenses

Featured in Orthogon

The Investigation of the Variation and the Correlation of the Optical Elements of Human Eyes

by

Solve Stenstrom, M.D.

Translated from the original German by

Daniel Woolf, O.D.

School of Optometry, Columbia University, New York, New York

The anterior-posterior diameter of the eye and the role this plays in refractive errors. Including much other pertinent data. This translation reviewed and approved by Stenstrom.

"His monumental monograph was published in German in 1946 and translated into English by D. Woolf under the auspices of the American Academy of Optometry." —A. Linksz, M.D., Physiology of the Eye, Vol. I, 1950.

This is a monograph that belongs in every optometrist's library. It is the most significant contribution to ophthalmic literature of the decade.

72 pages, 16 illustrations, board covers.
Price, postpaid, $1
Order by number, Monograph No. 58

AMERICAN ACADEMY OF OPTOMETRY

1502 Foshay Tower Minneapolis 2, Minn.

Only you can inform OPINION MOULDERS of your community with . . .

Visual Digest

—"The Magazine with Vision"

VISUAL DIGEST is planned and edited for public education about optometry. It lays the foundation in your community for the correct and truthful understanding of your profession.

Only **you** know who are the influential people in your community. Only **you** can give them this information they should have about optometry. Here is **your** personal opportunity to further the progress of your profession locally and at small cost. Enter now your gift subscriptions to VISUAL DIGEST for the opinion moulders of your community.

Visual Digest Subscription Schedule . . .

Single copies 25c
$1.00 order ..... Net $1.00 (4 copies)
$10.00 order ..... 5% discount, net $9.50 (40 copies)
$20.00 order ..... 10% discount, net $18.00 (80 copies)
$100.00 order ..... 15% discount, net $85 (400 copies)
Write for additional discounts on orders of two to four thousand copies.

Address Subscription Orders to

VISUAL DIGEST

518 Wilmac Building
MINNEAPOLIS 2, MINN.

Mr. John Q. has a chip on his shoulder...

He's hot under the collar. And he's beefing away in a voice that gets increasingly loud that you are "*soaking*" him with unjustified high prices. What a lot of nonsense! What a gross misconception!
But wait! How can you blame the guy? He doesn't know the facts of ophthalmic life. He has heard some *gossip*, unfortunately. This gossip has put us in a shady light. Bait advertising, rebates, slipshod service, and other misdemeanors by the tiny minority have given the whole industry a black eye.

How do we smarten up John Q.? Support the B.V.I.! Add your dollars to those of others. When you give to the B.V.I. you give to yourself! Build a bigger fund so that a harder-hitting and faster-acting job may be done . . . for *you* and for all who seek better consumer attitudes!

EYE CARE
Nothing you buy gives you so much, yet costs you so little

BETTER VISION INSTITUTE, INC., 630 FIFTH AVENUE, NEW YORK 20, N. Y.
THE NEED FOR EDUCATION NEVER ENDS

SPECIAL CLINIC TRAINING

Unusual opportunity for graduate review in optometric techniques including O.E.P. . . . . visual training . . . . . abnormal vision problems . . . . . ocular pathology . . . . . State board review—under regular staff, both optometric and ophthalmological.

Available for optometry graduates—young or older—at optometry 's largest eye clinic. More than 500 patients a week. Cross-section of interesting cases.

Arrange your own schedule—February through May, day or evening period. Write for particulars.

Northern Illinois College of Optometry

OPTOMETRY'S OLDEST INSTITUTION • FOUNDED 1872

4170 Drexel Boulevard Chicago, Ill.

WHERE ACCURACY COUNTS

Specify Kurovas

Kurova single vision give prescription fidelity from center to periphery. Kurovas are built on 34 base curves, are corrected for both marginal errors as astigmatism and change in power, have a precision instrument-type polish. We stock and heartily endorse Kurovas for fine single vision glasses.

SUPERIOR SERVICE

SUPERB OPTICAL PRODUCTS

Minnesota Optical Company

Exclusively Wholesale — For the Profession

Box 231 Minneapolis 8

CLOSING OUT!

DVORINE COLOR CHARTS

2 volumes, 130 Pseudo-isochromatic plates

SPECIAL OFFER

WHILE THEY LAST!
REDUCED FROM $25.00 TO

$10.00 per set

*ORDER NOW — PAY LATER IF YOU WISH**

RUSH THIS COUPON

ISRAEL DVORINE, O. D.
Dept. B
2328 Eutaw Place
Baltimore 17, Md.

New Price
$10.00

Please send me the two volumes of "DVORINE COLOR PERCEPTION TESTING AND DIAGNOSING CHARTS" with booklet of directions. If I am not pleased with them, I shall return them to you within 10 days; otherwise I shall mail you a remittance within 30 days.

Name .....

Street .....

City ..... Zone ..... State .....

*Postage prepaid if check accompanies order. Same return privilege. Weight 4 pounds.

"Why Should a Refractionist Prescribe Therminon?"

One Of A Series of Questions and Answers About Therminon, America's Finest Absorptive Lenses.

"BECAUSE Therminon lenses absorb the infra-red radiations and prevent these radiations from reaching the eye."
It has been proven that certain of the invisible rays of the spectrum play an important part in the formation of cataract. The infra-red rays must be taken into consideration when a search is made for the cause of cataract. Artificial light contains more of these rays than are found in sunlight.—Dr. Neville C. Schuler, Opt.D., F.I.O., R.O. Cataract, Its Prevention and Treatment, 1938, page 29.

Write Today For FREE Folder "Why Should a Refractionist Prescribe Therminon Lenses."

COOL FILTERED LIGHT IS BEST FOR SIGHT

Therminon LENSES

THERMINON LENS CORPORATION
63rd at University Des Moines, Iowa

BAYFAIR NUMONT

Bay State Numounts

WITH TRI-SPRING STRAP

The distinctive lines of Baystate Mountings which set them apart from common styles appeal to people of good taste.

Johnson Optical Company

Branch Laboratory
526 Board of Trade Bldg.
DULUTH, MINN.

Main Office and Laboratory
301 Physicians and Surgeons Bldg.
MINNEAPOLIS ATlantic 2469

BACKED BY 118 YEARS

of

OPHTHALMIC EXPERIENCE

American Optical
COMPANY

• Are you one of the thousands of Eye Specialists who have prescribed ***more than 150,000*** Keystone Home Training Services?

For strabismus and chiroscopic drawing

If so, you will be glad to know that *New Services* are now ready for your prescription, at your optical supply house.

NEW Features:

New Plastic Stereoscope, attractive, lighter in weight, warp proof, permanently accurate.

New Manual for Patients has easily understood directions; record form gives the doctor a quick check on progress.

New Guide for Doctors is a most comprehensive and direct technical manual on home-training orthoptic procedures.

New Compact Package takes only half the previous space; easily carried by patient from home to office.

SOLD ONLY ON PRESCRIPTION

Carried in stock by most Optical Supply Houses.

Widely prescribed for asthenopia after refraction, and for discomfort due to near-point work. Many eye specialists use them *routinely* for: Adjustment to Bifocals. Esophoria and Exophoria. Premature Presbyopia. Low accomodative Amplitude in younger patients. Slowness in Changing Fixation from far-point to near-point. Difficulty in Accepting Rx. Ciliary Spasm. Faulty Stereopsis.

Write for circular—or for the new Doctor's Guide (no charge).

KEYSTONE VIEW CO., Meadville, Pa.

PIONEERS IN VISUAL TRAINING EQUIPMENT

OPHTHALMOLOGY

Section XII of Excerpta Medica

An abstract journal covering ophthalmology in all its aspects, including research and methods in the physical, chemical, physiological and medical fields. Non-ophthalmological specialists will find much of interest about problems of optics and vision. Included also is information about the prevention of blindness, the increase of working capacity, and the extension of knowledge in the ophthalmological fields.

The international board of editors includes such well-known names as Francis H. Adler, Hans Barkan, William L. Benedict, Conrad Berens, Hermann M. Burian, J. S. Friedenwald, Lawrence T. Post, D. Vail, and Alan C. Woods.

Published monthly, 1 volume a year

Subscription price $15.00 a volume

THE WILLIAMS & WILKINS COMPANY

Mt. Royal and Guilford Aves. **Baltimore 2, Maryland**

Agent for North and Central America

A *distinctive* **NEW** *frame*

Bellaire

by Victory

An elegant newcomer to the Victory family, Bellaire is a gracefully flared high fashion frame designed for the woman of cultivated taste. Conceived and crafted with the same outstanding skill and ophthalmic precision that has become the hallmark of Victory.

Offered in De Luxe ornamentation in metallic tones of red, blue, grey, and gold . . . and standard Victory colors.

Available through your optical supplier.

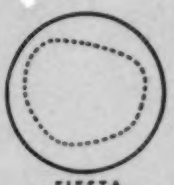
VICTORY OPTICAL MANUFACTURING COMPANY

NEWARK, N. J. CHICAGO, ILLINOIS • LOS ANGELES, CALIF.

Cut of Shuron's

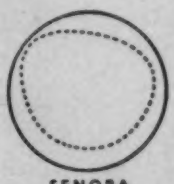
54 m/m ROUND MENISCUS LENS

practically all prescription lenses, whatever the size or shape, can be cut and edged speedily and with room to spare. In the sketches at the right, the broken lines indicate how generously the Shuron Meniscus lens surpasses the *actual* requirements for producing three of today's most popular styles. Note especially that this lens is *round*—thus providing an extra margin beyond square 54 m/m sizes.



FIESTA

STAG



SENORA

Established in 1864

Shuron OPTICAL COMPANY, INC.
GENEVA, N.Y., U.S.A.
Originators also of Beaded Frame and Barset mountings